Maine Prepares Conference
Augusta Civic Center
Day One
April 19, 2016, 3.30-4.10pm

Maine's Dam Safety Program

Presented By

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&
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Maine Department of Defense, Veterans and Emergency Management (MDVEM)
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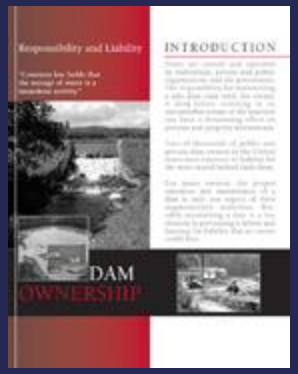
Information about Dam Safety
from
The Association of State Dam Safety Officials (ASDSO)

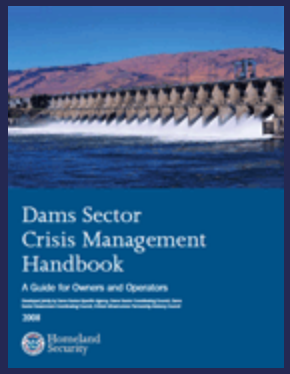
http://www.damsafety.org/

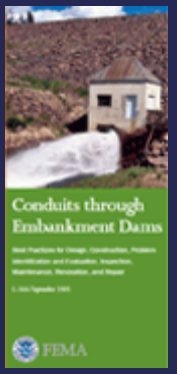
An Organization Dedicate to Promoting Dam Safety and an Excellent Source of Information about Dam Safety

The following excellent guides are available on-line at;

http://www.damsafety.org/media/documents/owner%20documents/start.htm?2014







MEMA Handouts

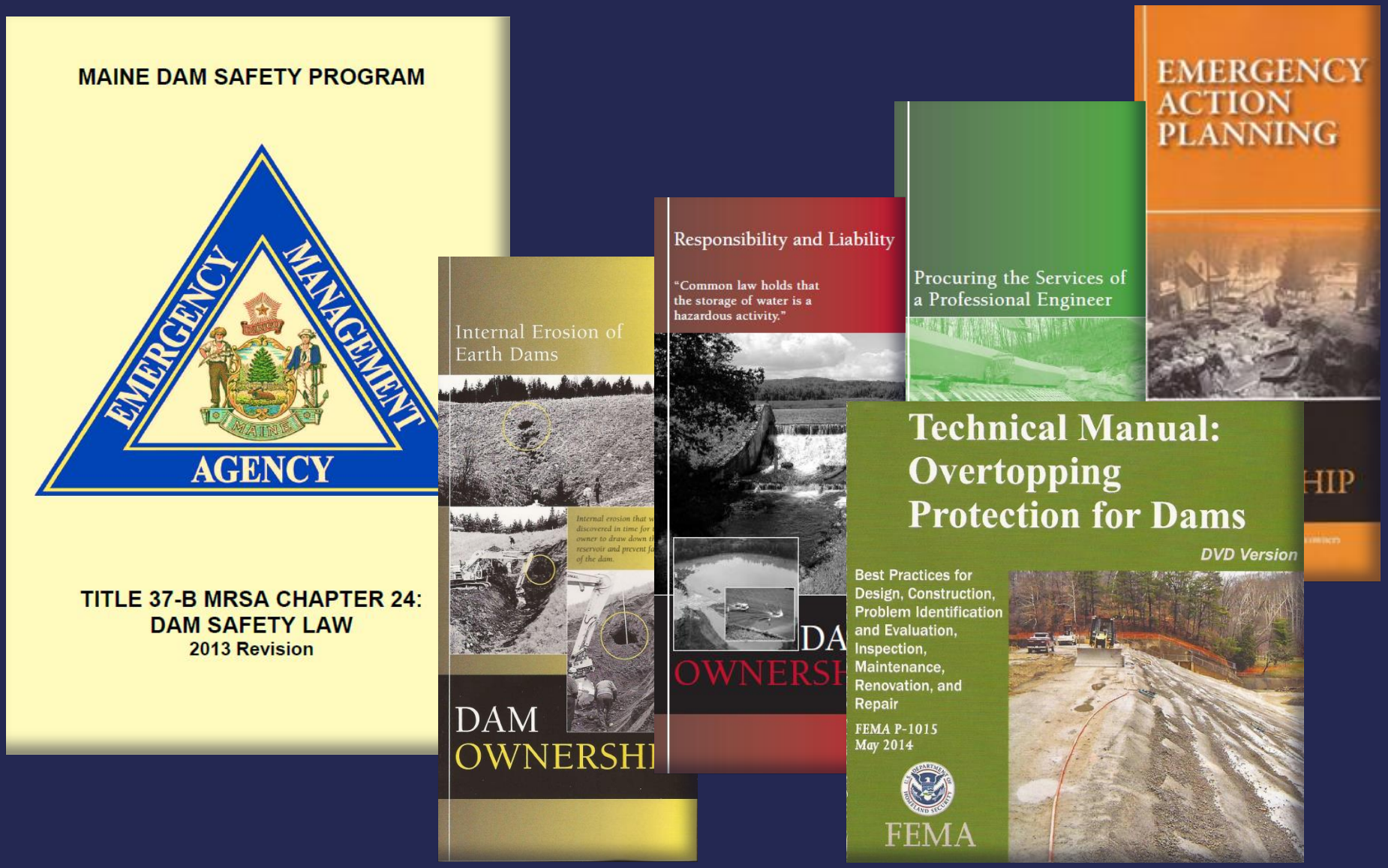


Table 1 – Dams in ME & Their EAP Status

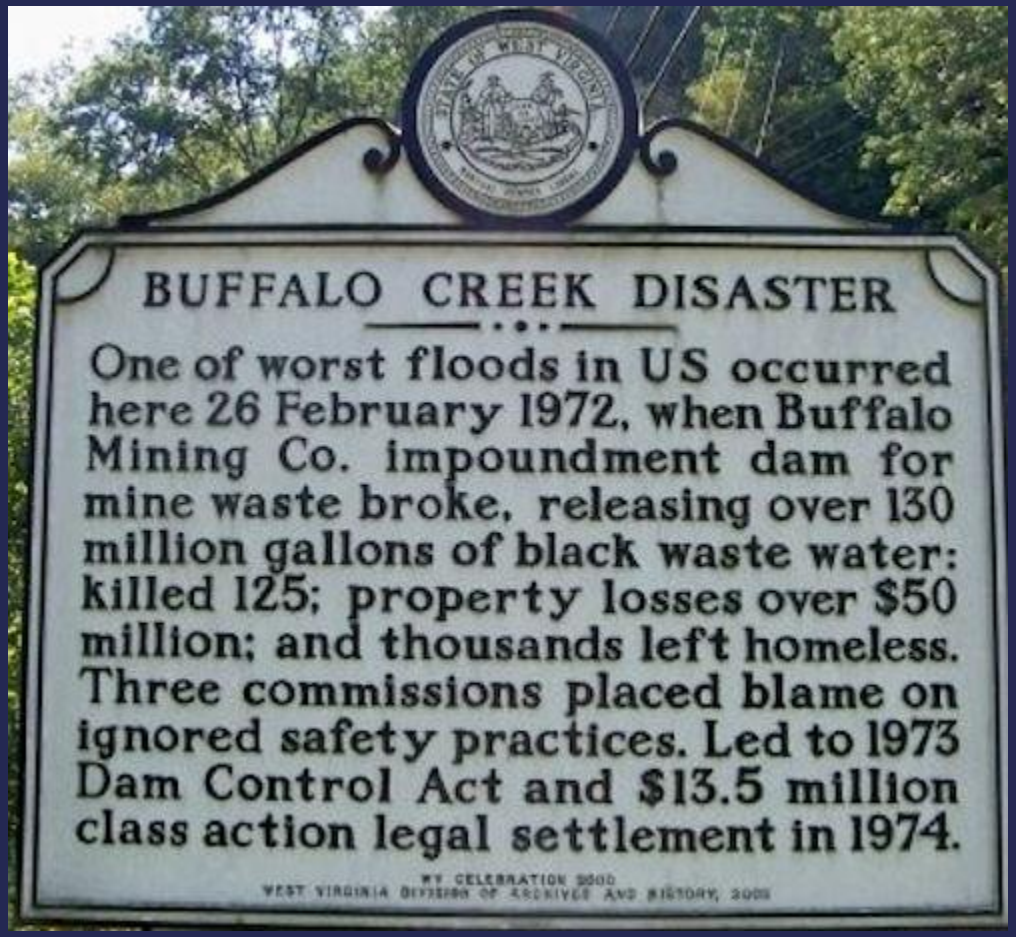
TABLE 1	Maine Dam Safety Program (MDSP)			FERC Regulated Dams in ME			NH DES Dams that could affect ME		
Hazard	# Dams	# EAP's	% EAP's	# Dams	# EAP's	% EAP's	# Dams	# EAP's	% EAP's
High	30	30	100%	33	33	100%	19	19	100%
Significant	73	70	93%	9	9	100%	30	20	67%
Low	495	Not required	0%	121	32 (7)	32%	10	4	44%
Total	598	98		163	47		59	43	

Table 2 – Condition of HH & SH SRD's 2011/12

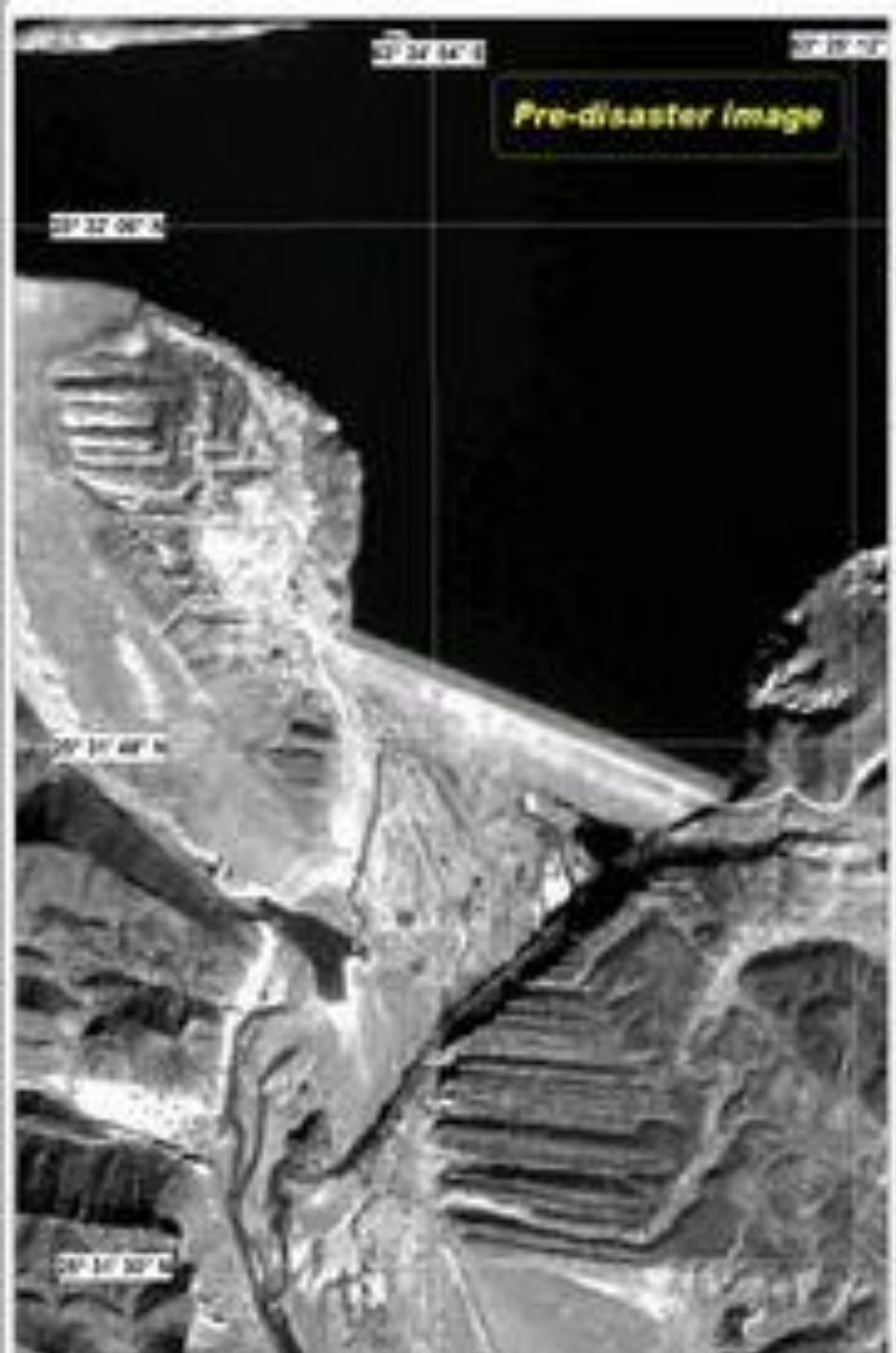
Dams		Condition of Inspected Dams		
Dam Hazard	**Number of Dams**	**Satisfactory**	**Fair**	**Poor**
High	**27**	10	13	**4**
Significant	**72**	21	24	**25**
Totals Assessed	**99**	31	37	**29**
% SRD's Which Require EAP's		31	38	**29**
Low	**505**	In terms of State Dam Safety Law – Title 37B c24 low hazard dams do not require condition inspections		

Origin of the National Dam Safety Program

• The Buffalo Creek Disaster



- ❑ Following the failure of Buffalo Creek dam, Congress passed US Federal Law PL 92-367 on Aug 8, 1972.
- ❑ This act authorized the Secretary of the Army, through the Corps of Engineers, to undertake a National Program of Inspection of Dams (NPID), to protect human life and property.


Pre-disaster image


Post-disaster image

Mining Town 'Wiped Out'

MAN, W. Va., (UPI) — Between 80 and 90 persons died Saturday when a rain swollen coal slag cofferdam burst, sending a three-foot wall of water crashing through a valley crowded with more than a dozen small mining towns. It was initially estimated that nine persons had died after the dam's retaining walls, holding back 20 feet of water in a reservoir measuring 200 feet in length, collapsed under the strain of three inches of rain ontop of a recent 20-inch snowfall.

The estimate multiplied to between 80 to 90 after officials at the Amherst Coal Co. notified Gov. Arch Moore later Saturday that the Appalachian mining community of Lorado, near the headwaters of Buffalo Creek, "was completely wiped out" in one of West Virginia's worst flood disasters.

Snow

Charleston Daily Mail

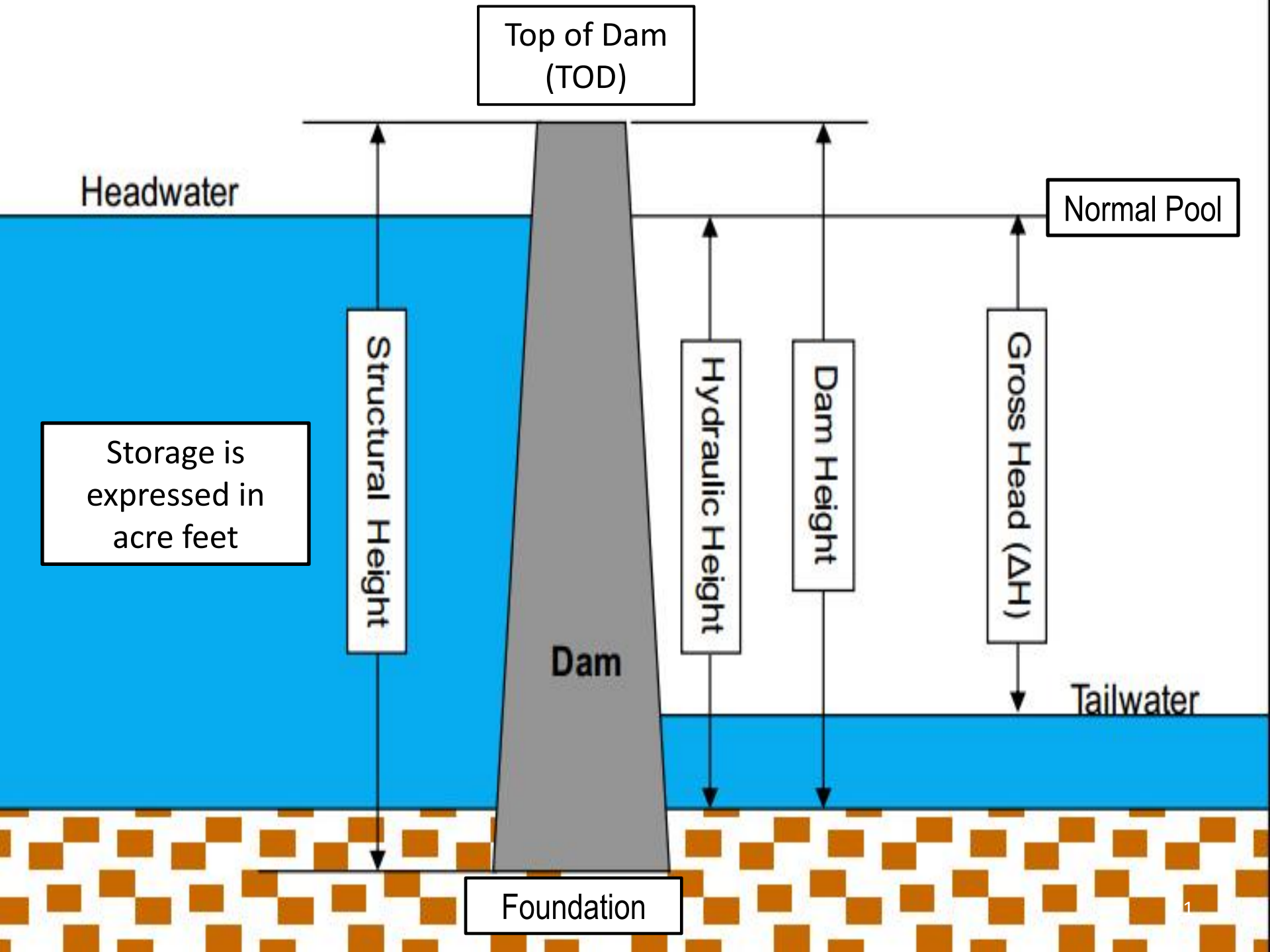
FINAL EDITION

Logan Flood Toll 66; 400 Missing

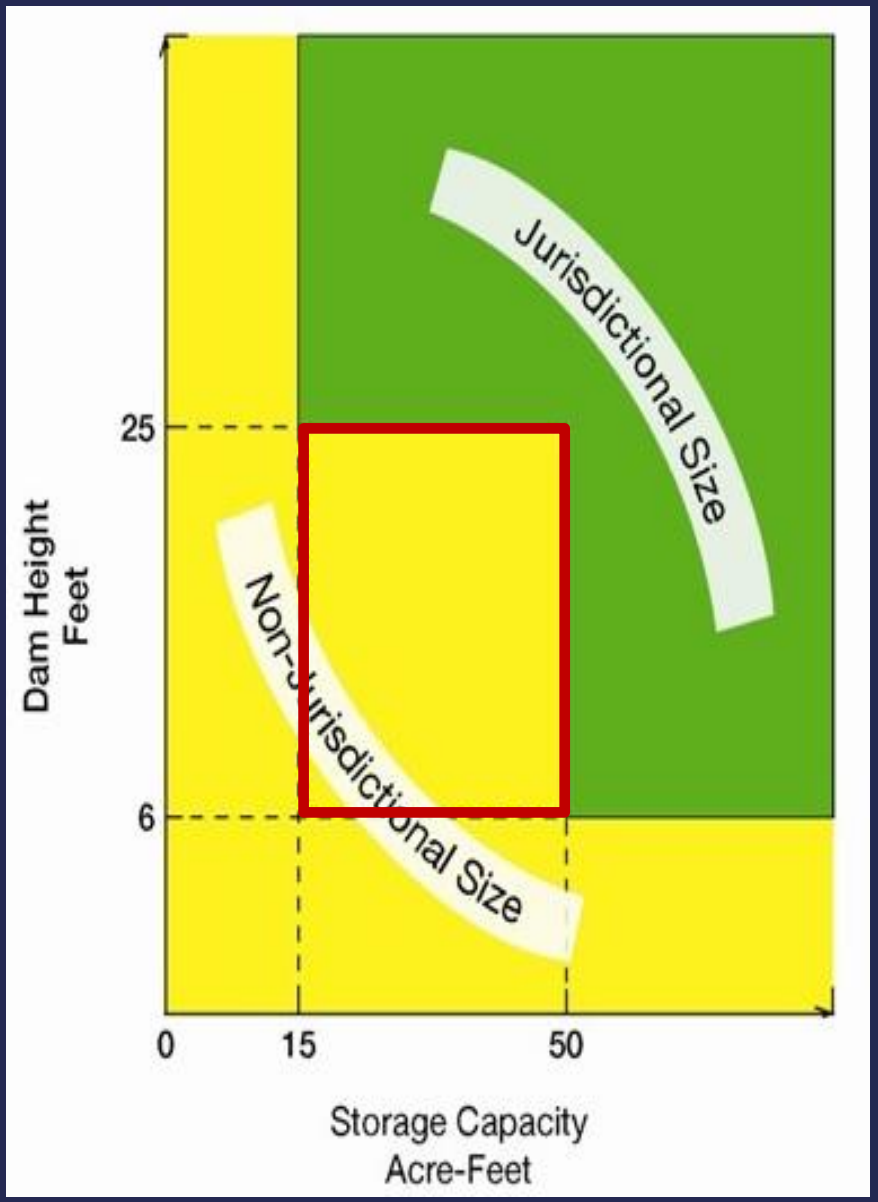
Hundreds Search Disaster Area; Cause Of Break Gets Attention

Moore Stresses Relief For Living

Definitions

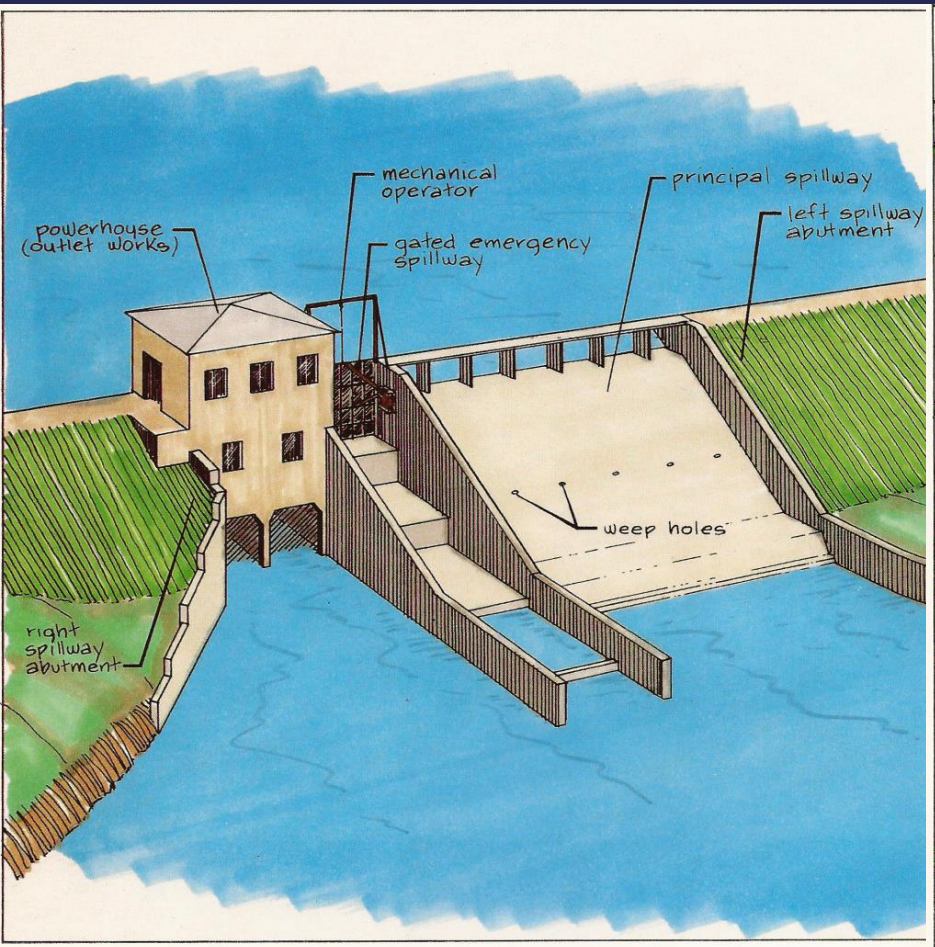

Top of Dam
(TOD)
Headwater
Normal Pool
Storage is
expressed in
acre feet
Structural Height
Hydraulic Height
Dam Height
Gross Head (ΔH)
Dam
Tailwater
Foundation


Appurtenant Works

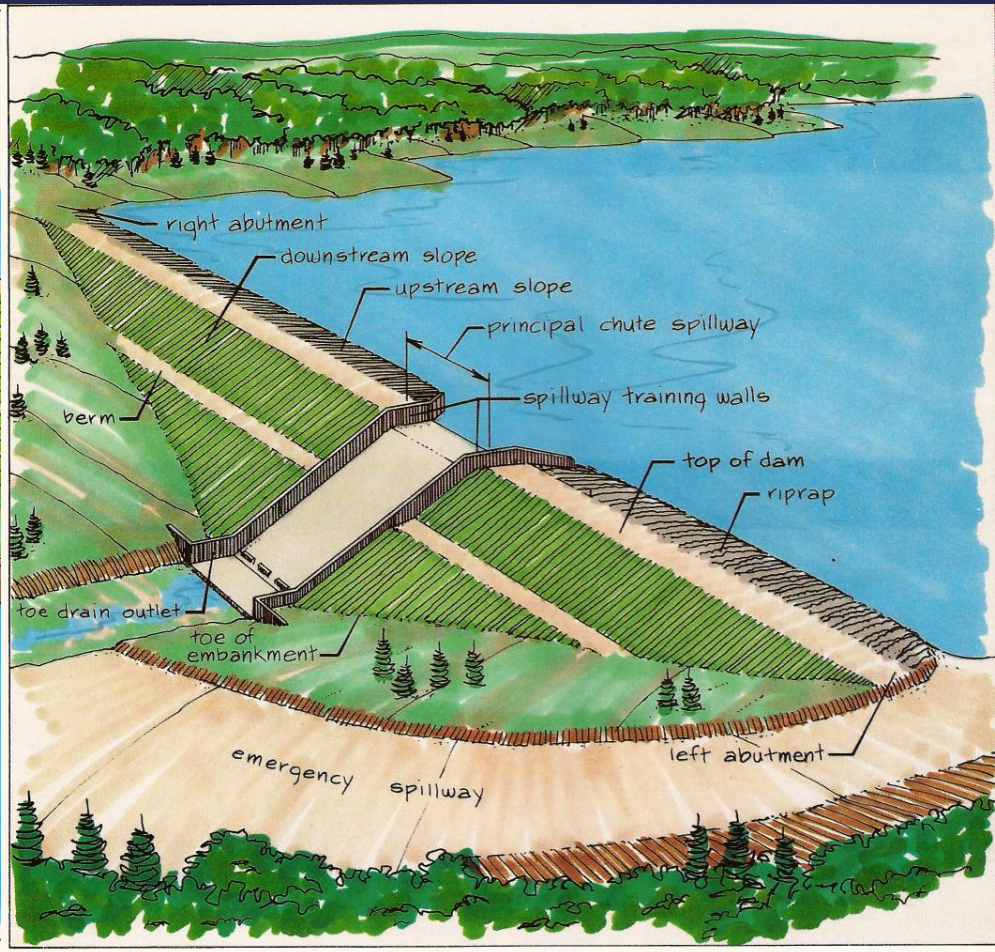


- Jurisdictional Dams those > than 25' in height, storing more than 15 acre-feet; and those > 6 feet in height, storing more than 50 acre-feet.
- 1 acre foot = 203,860 gallons or 2.72 million pounds)
- Normal Storage – is the useful volume of water impounded by the dam at normal pool. About half the NP area multiplied by dam height.
- Potential Energy Stored in a Dam - is indicated by the product of the dam height and its storage. That would also be its generating potential.

Principal Features of a Dam



principal parts of a dam

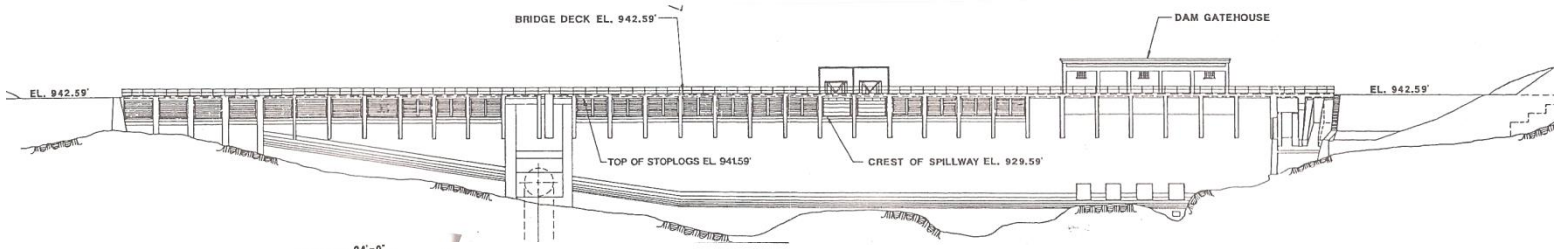


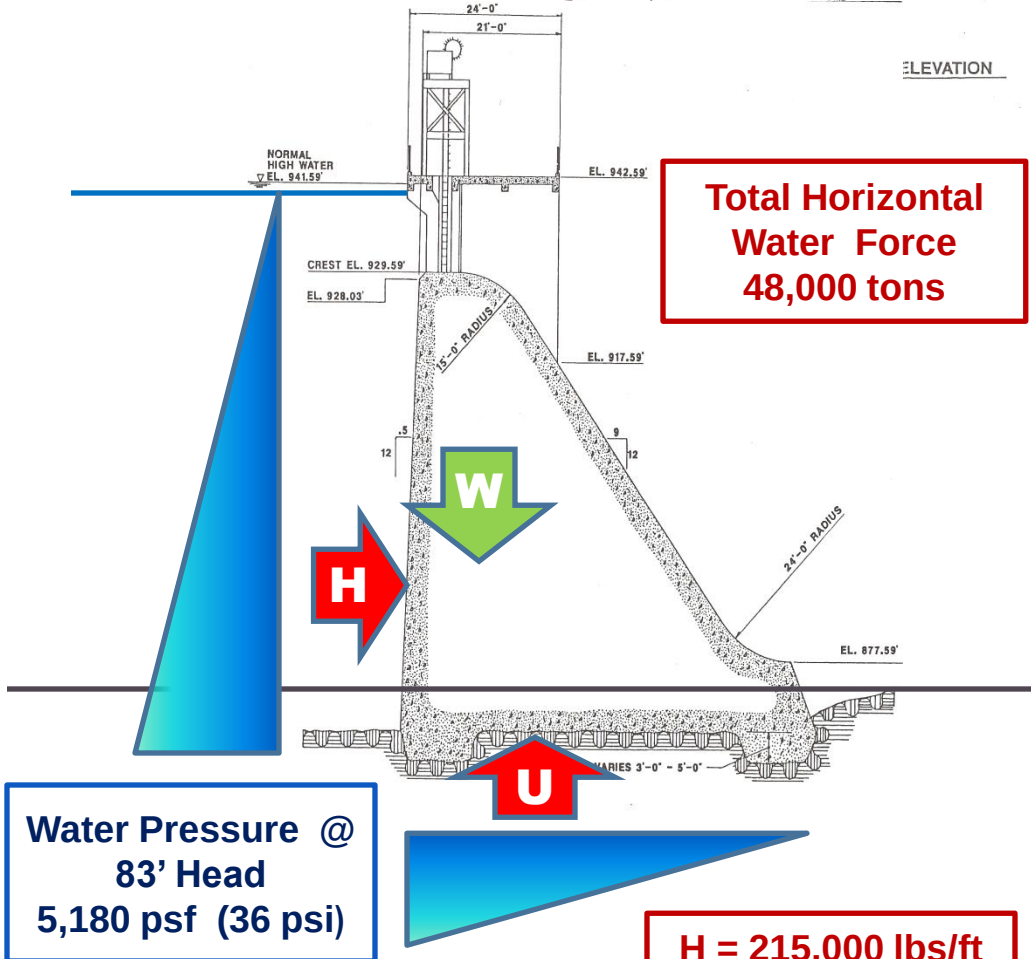
principal parts of a dam

Forces on a Dam

Example; Ripogenus Dam

Forces Acting on a Concrete Mass Gravity Dam





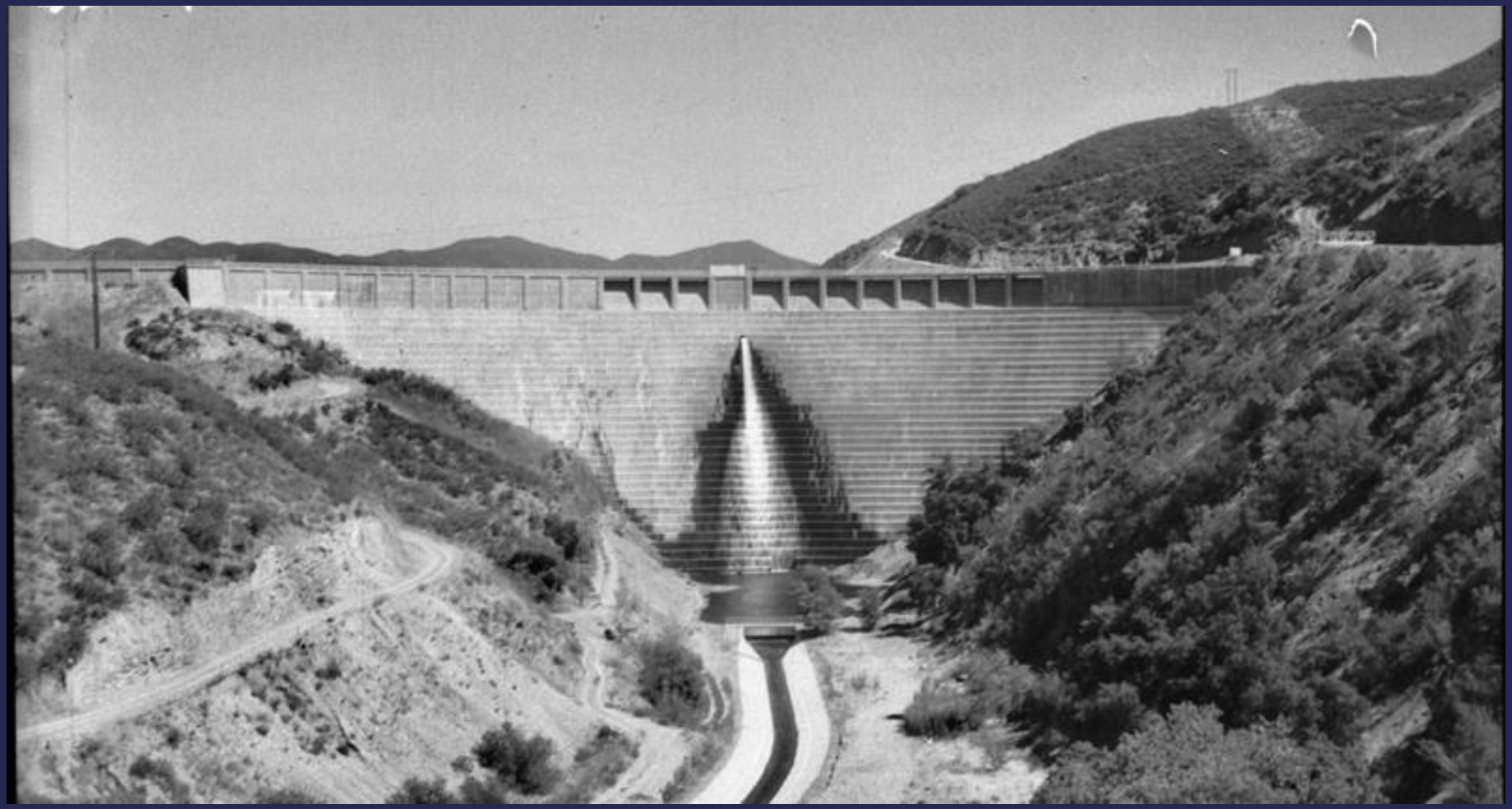
Total Horizontal Water Force 48,000 tons

Water Pressure @ 83' Head 5,180 psf (36 psi)

H = 215,000 lbs/ft
U = 155,000 lbs/ft

Example - Ripogenus Dam
Concrete Mass Gravity 83' High, 780' Long

St Francis Dam – 1928 – Concrete Mass Gravity



205 feet high, 1225 feet long and 160 feet thick at the stream level.
175,000 cubic yards of concrete, build in a year at a cost of $1,250,000.

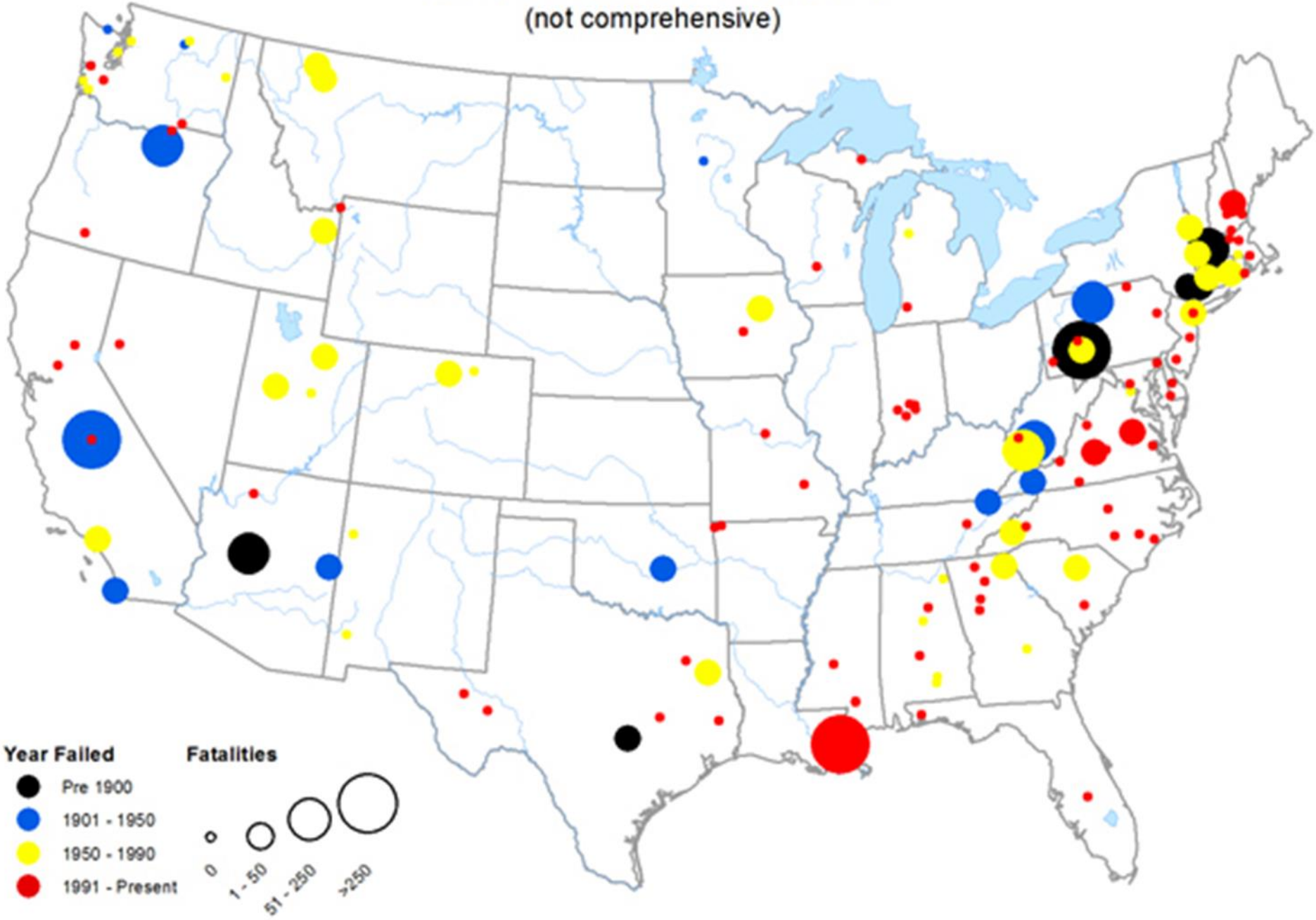
St Francis Dam - Foundation Failure - March 12, 1928

St Francis Dam Failure - March 12, 1928

Historic Dam Failures in the US

USA Dam Failures

(not comprehensive)



Dam Failures in the US between 1900 and 1975

Type & Percentage

1) Overtopping 34% (Inadequate Spillway)

2) Foundation 30% (St Francis)

3) Piping & Seepage 28% (Ivanhoe)

4) Other 8%

Overtopping Failure

Generally Caused by an Inadequate or Blocked Spillway

VIDEO-ASDSO-OVERTOPPING FAILURE -0:56

Southfork Dam failure - 1889. Overtopping caused breach. Johnstown was flooded in 30 minutes. The worst disaster in U.S. history at the time. Relief efforts were the first major actions of Clara Barton and her newly formed American Red Cross

Workers recovering a body from debris.

One of the hotels constructed by the American Red Cross to provide lodging to homeless flood survivors.

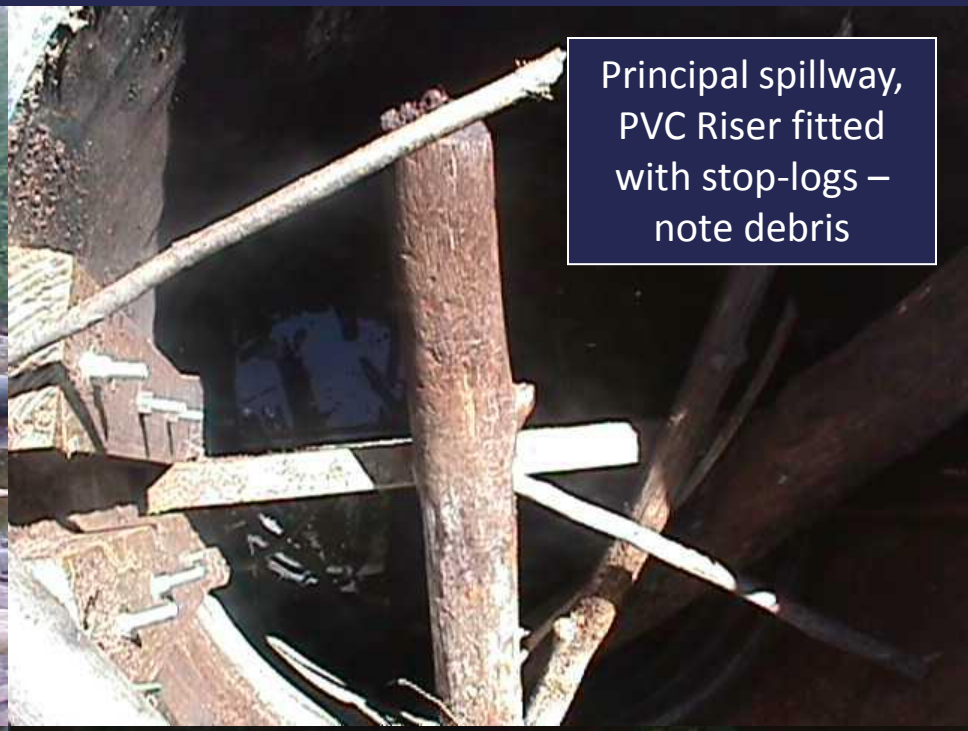
- 8/2/96 IFW built 10’ high, 30’ wide, 120’ long, earth dam to operate 4’ deep, to restore a historic lake. Volume earth 370 cy from old dam plus 490cy. USACE approved plan. No site investigation, design details, specs or as-built records found.
- Principal spillway; “Ducks Unlimited” design of PVC pipe. Control; a) stop-logs inside riser, b) beaver control.
- IFW memo 8/16/200 mentions 6-10 cy “native clay” placed around “HiCore” PVC pipe somewhere between stand pipe and outlet.
- Emergency spillway - 12’ wide , 12” deep, open channel near right abutment over the top of right dike.
- In 1996 IFW hired a backhoe and bulldozer and re-constructed dam. Specification included; excavation to “hardpan and ledge”, removal of old beaver dam, placement of 8”-12” mud on surface the dam after construction

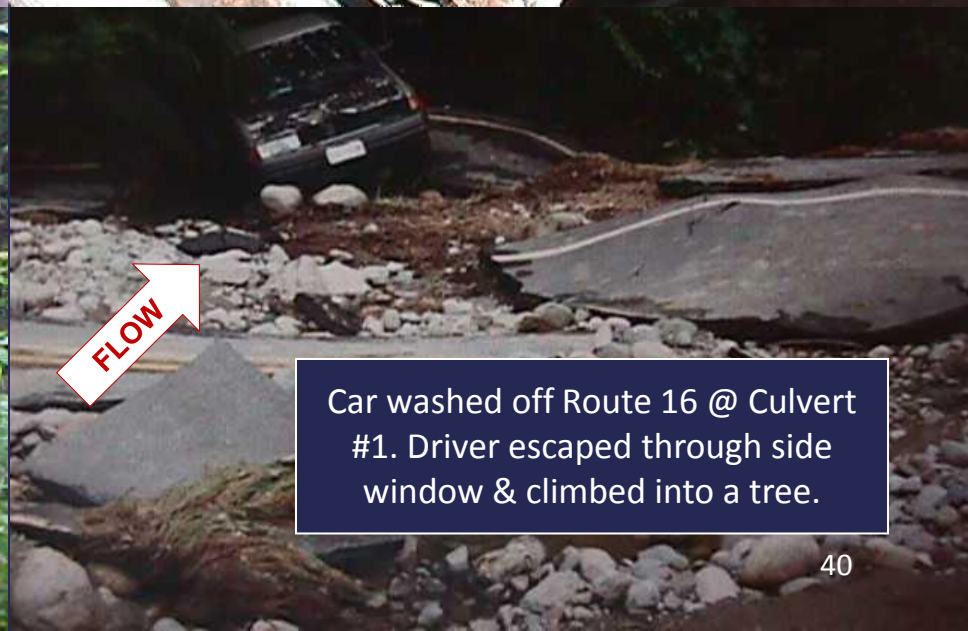
Owens Marsh Dam Under Construction

Owens Marsh Dam Completed 1996

Owens Marsh Dam - Overtopping Failure July 17, 2000

Owens Marsh Dam Overtopping Failure





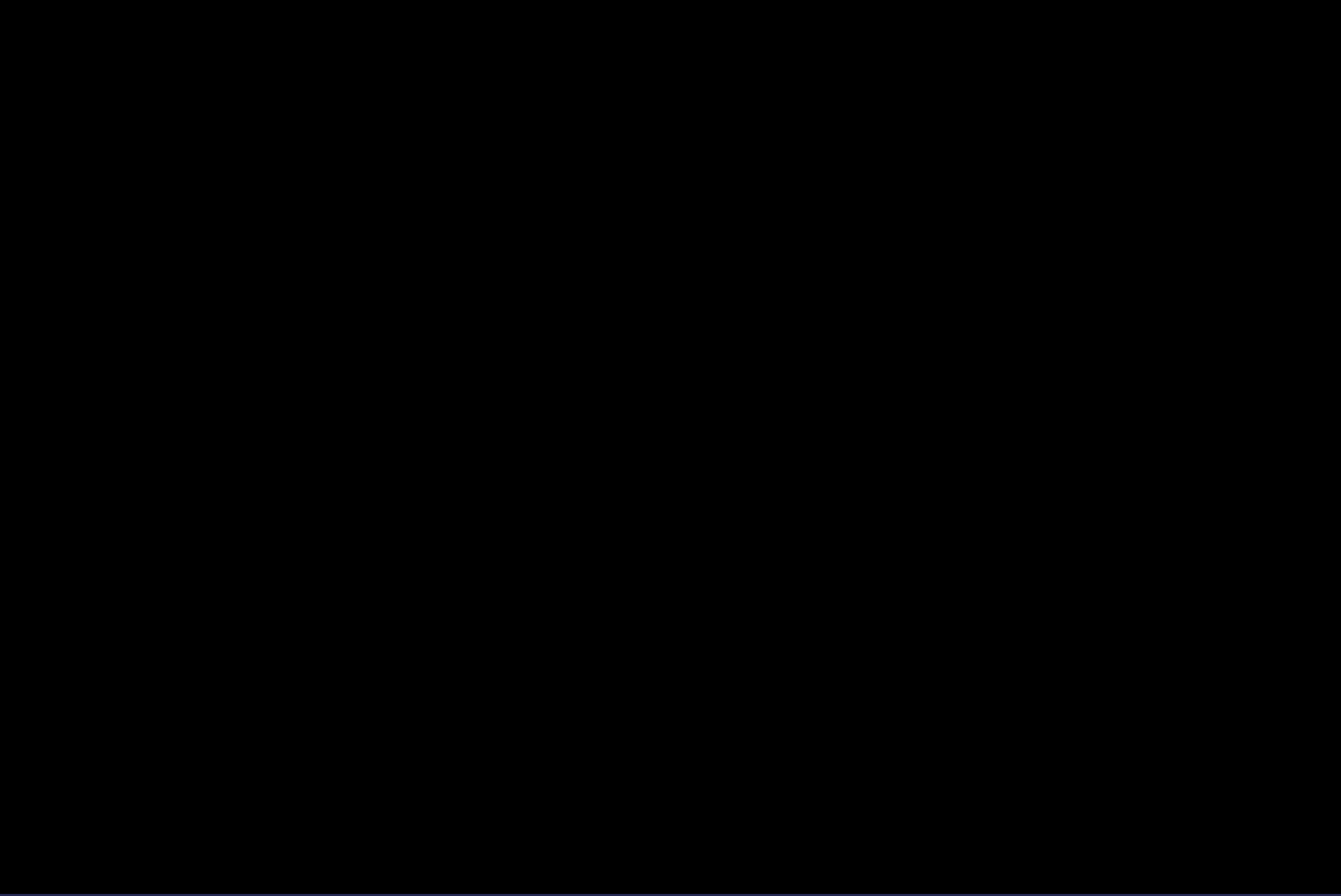
Owens Marsh Dam Overtopping Failure

Route 16 side-drain washout near culvert 2

Route 16 culvert 2

Erosion damage between culverts 2 & 3

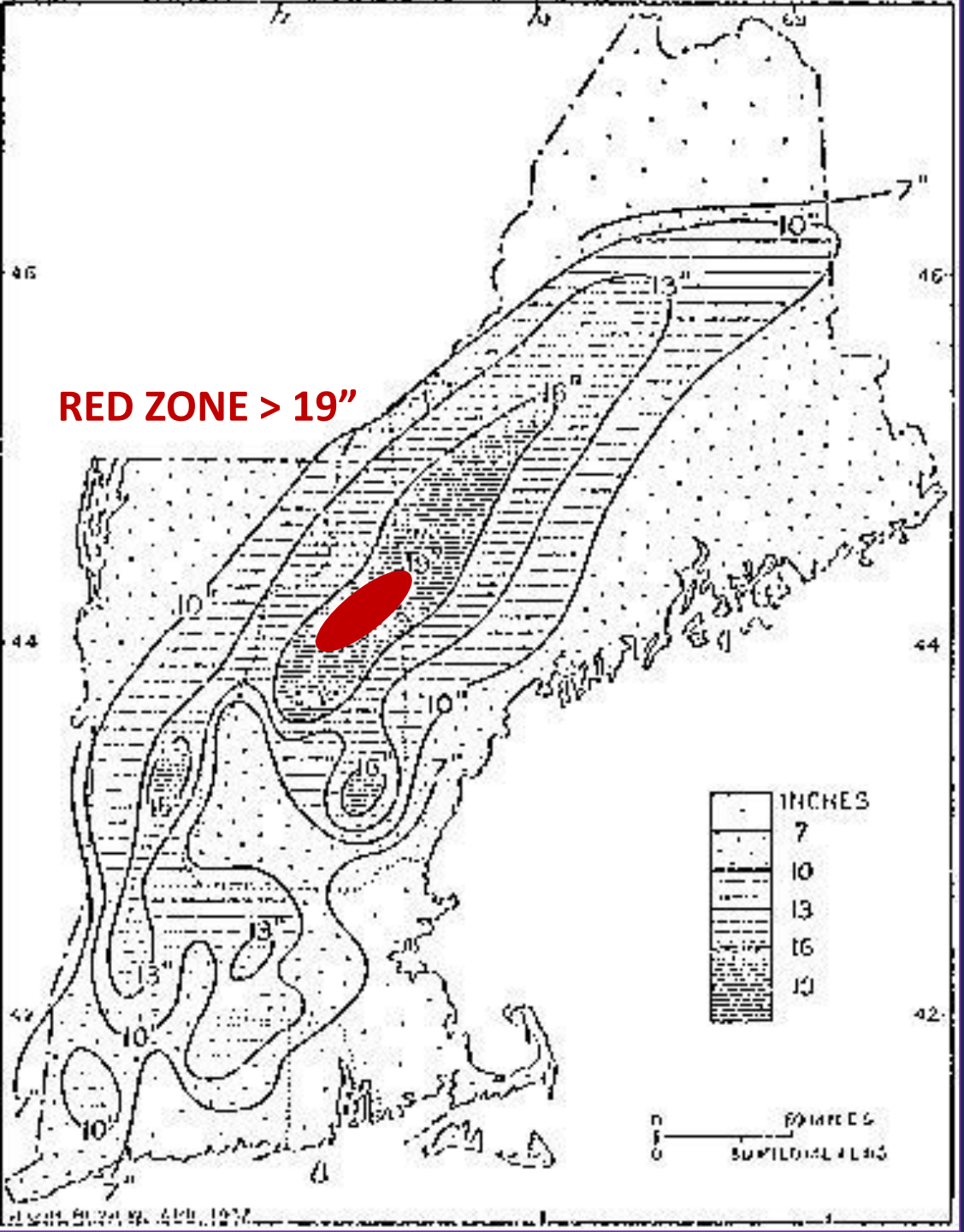
Replacement of culvert 3 by 48” cmp



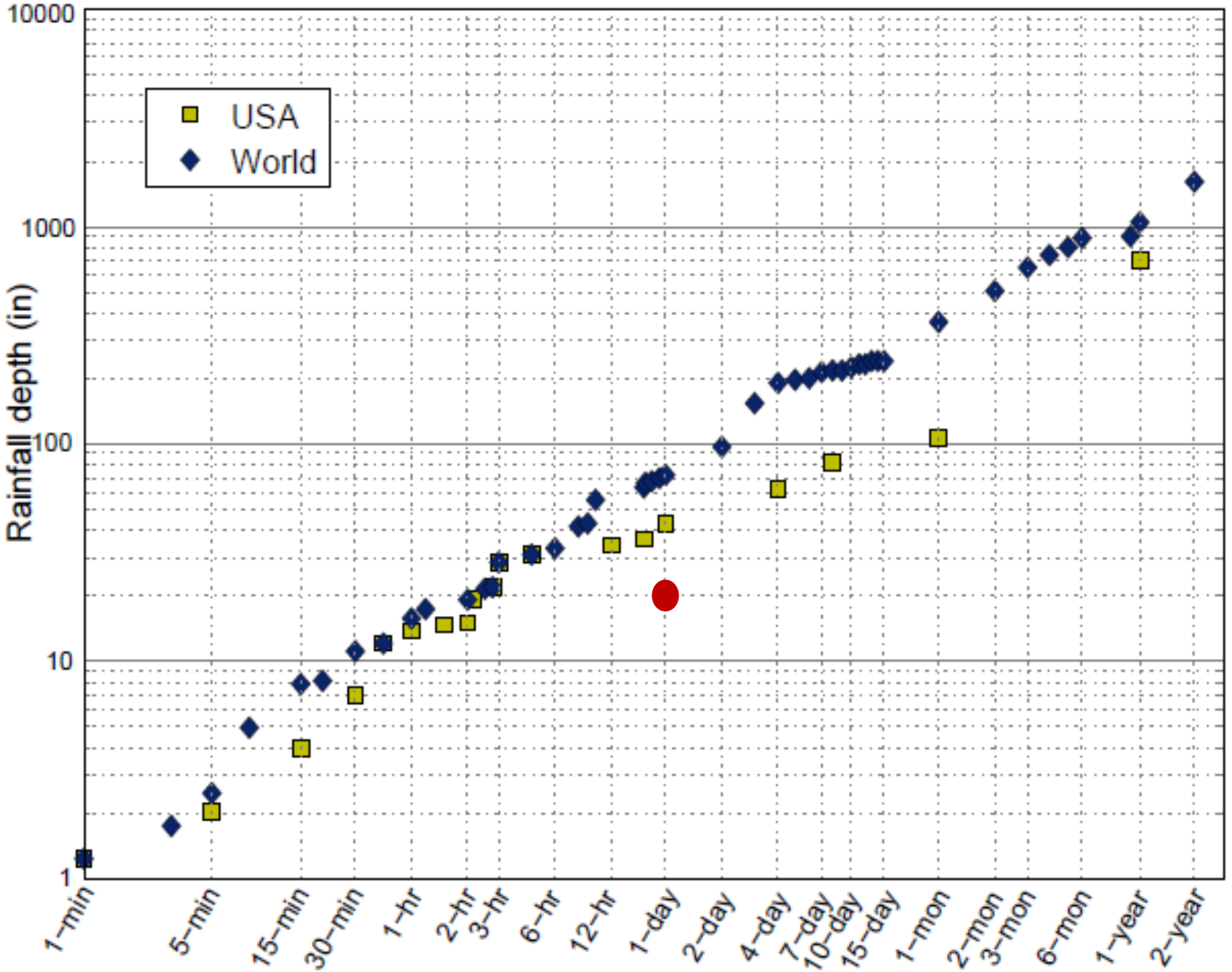
APPLE VALLEY DAM FAILURE VIDEO - Begin @ 1.50-2:0m PLAY

Extreme Rainfall

The 1937 Storm & Rainfall Distribution
and the
Overtopping Failure of Mill Pond Dam, Lovell, Maine



Rainfall distribution for the April 1937 Storm in Maine


10000
1000
100
10
1
Rainfall depth (in)
USA
World
1-min
5-min
15-min
30-min
1-hr
2-hr
3-hr
6-hr
12-hr
1-day
2-day
4-day
7-day
10-day
15-day
1-mon
2-mon
3-mon
6-mon
1-year
2-year

Mill Dam, Lovell, ME (1937) - Overtopping Failure

Mill Dam, Lovell, ME (1937) – Downstream Flooding

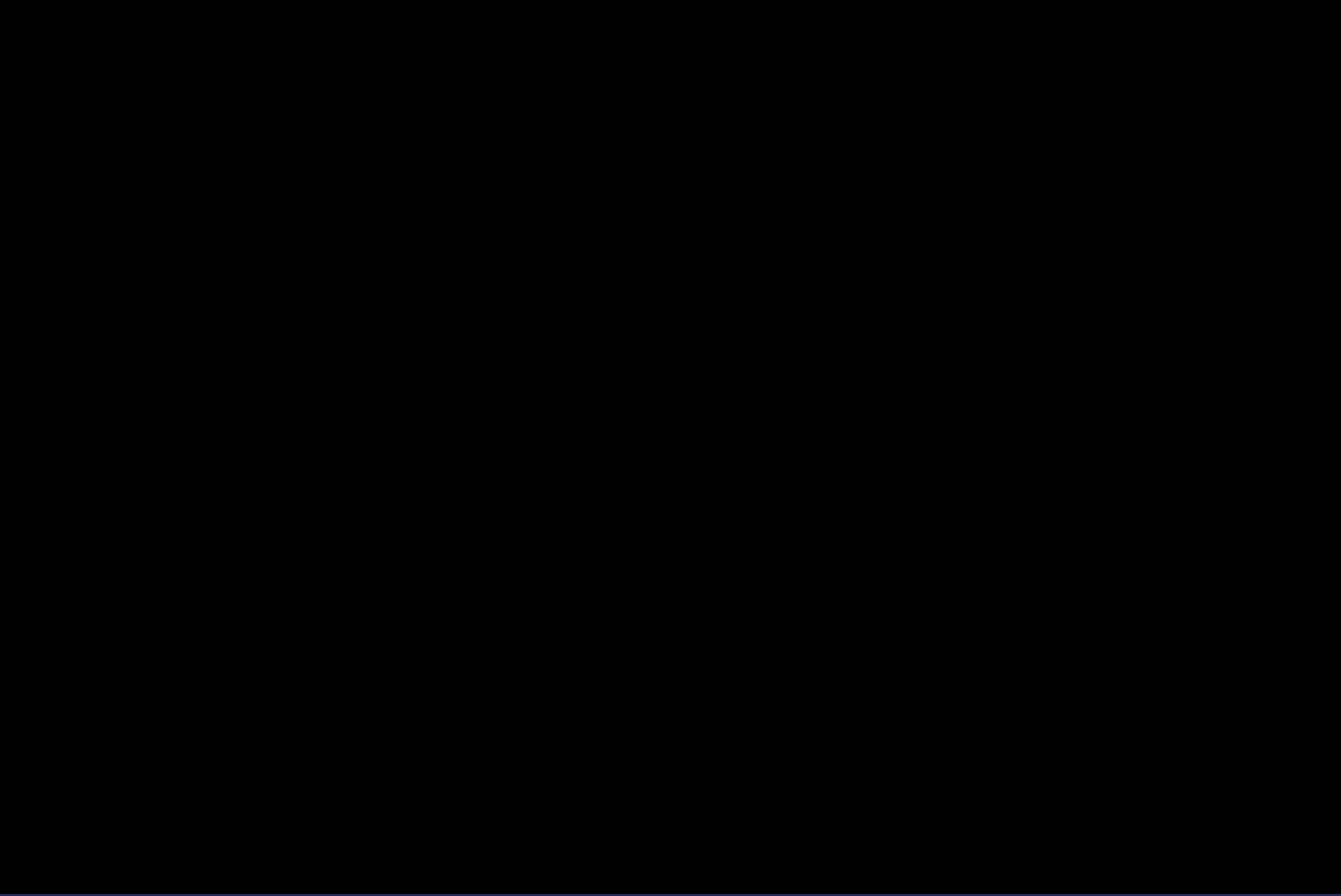
Instability Failure

Caused when the applied load overcomes resistance offered by structure

VIDEO-ASSDSO-INSTABILITY FAILURE 1.53m

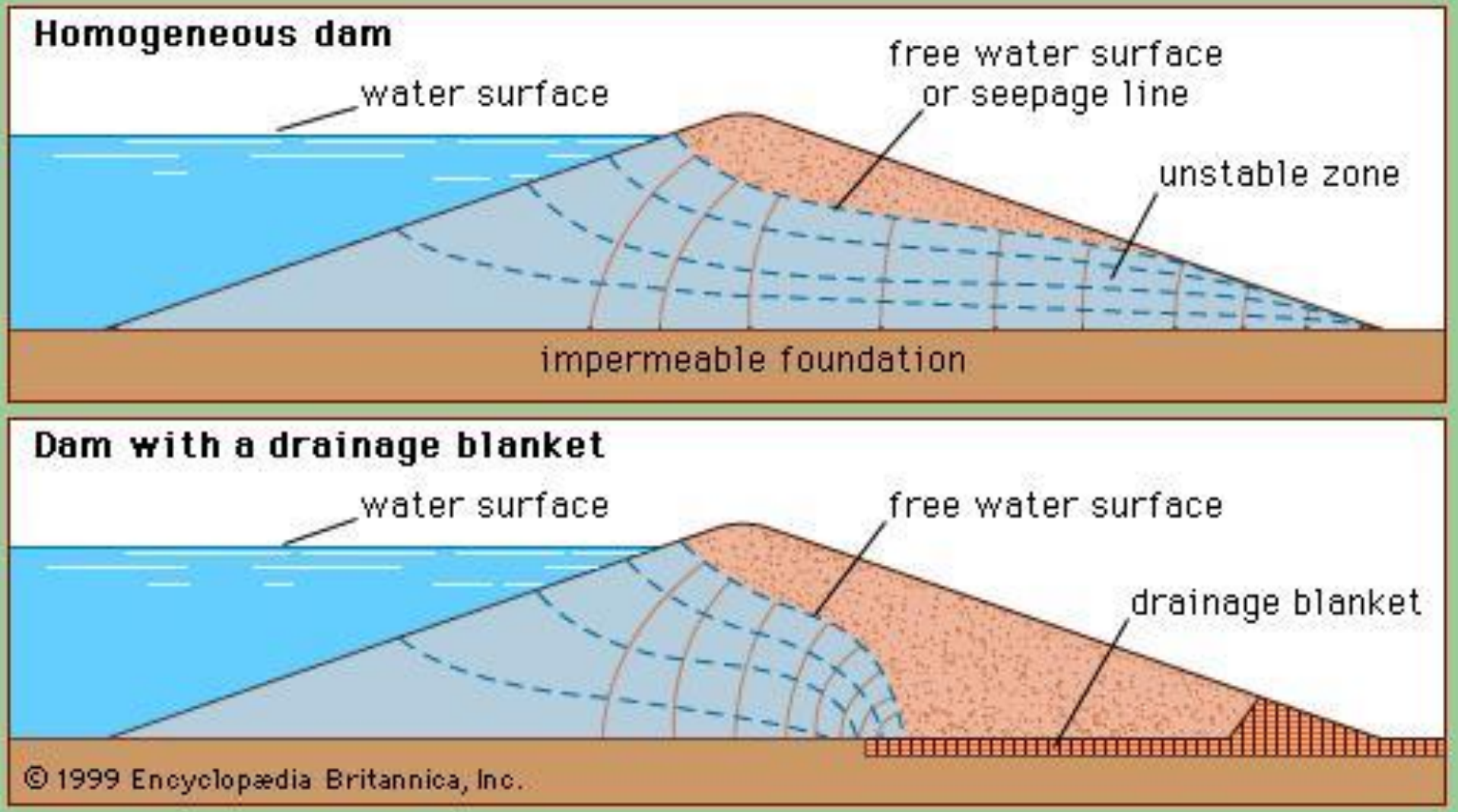
Seepage Failure

Generally Caused by inadequate internal drainage



VIDEO-ASDSO-SEEPAGE & PIPING 1.17m

Seepage through an Earth Dam

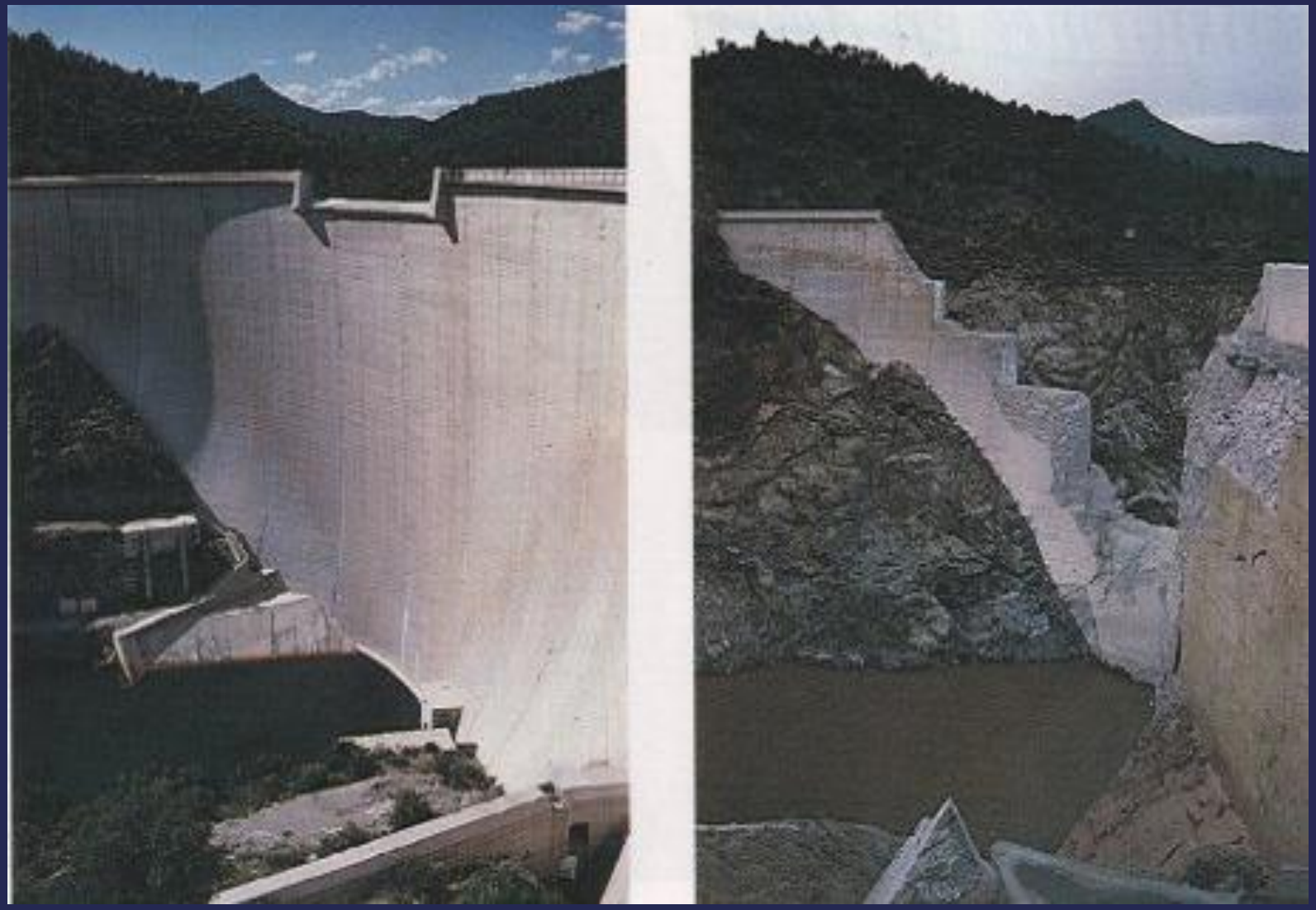


Ivanhoe Farming Company Dam. Breach caused by leakage of the outlet pipe within the dam initiating progressive internal erosion and the eventual breach of the dam

Foundation Failure

Generally Caused by undetected faults in the foundation leading to movement of the founding strata under load from the dam or reservoir

Malpasset Dam



Attributed to undetected faults in the foundation. Other factors; incomplete prospecting, design stresses highest ever used in concrete arch dam. Dam owner did not open bottom outlets until dam was close to overtopping.

Gleno Dam, Italy

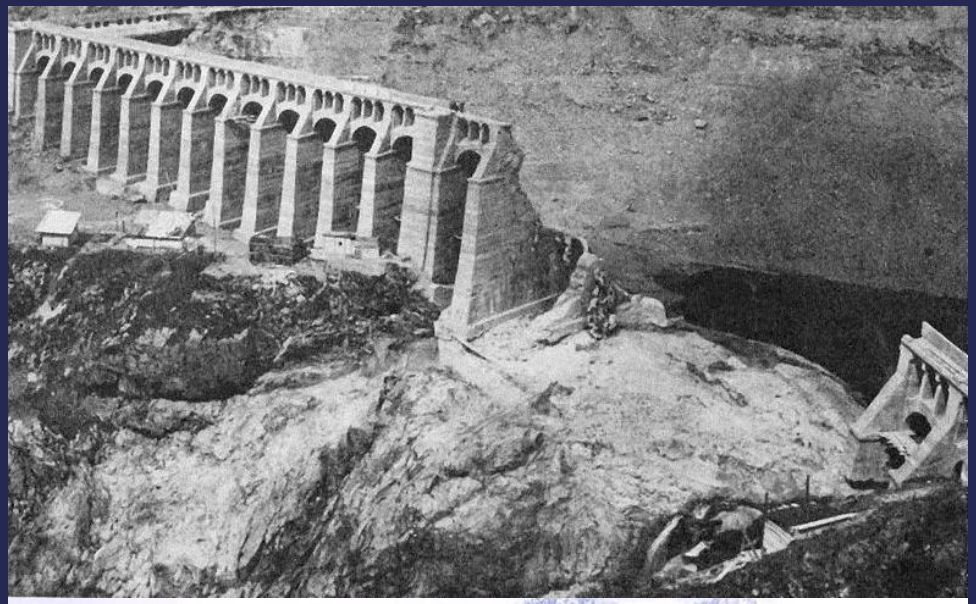
Failed - 6:30 am 12/1/1923 (first filling)

Deaths - 356 at least

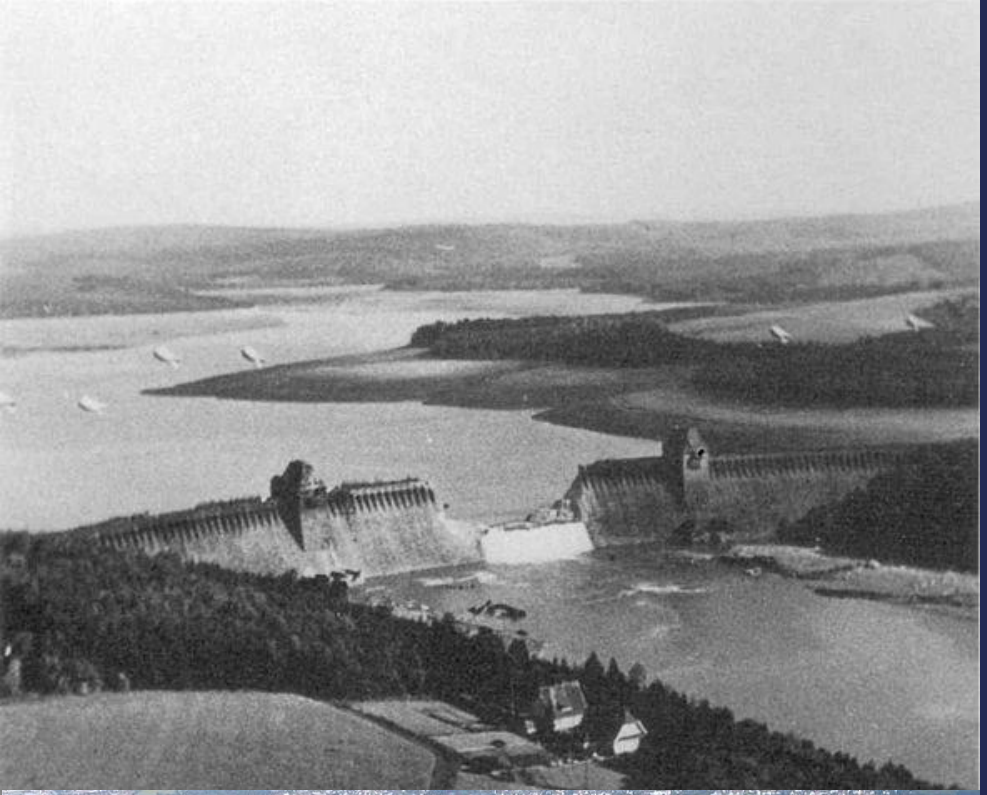
Flood - Dam elev. 5,036 ft. 3,648 acre feet of water released which flowed through four villages (Bueggio, Dezzo, Colere, Corna di Darfo), then into Lake Iseo, elev. 610 ft.

Cause – Buttress collapse attributed to; Design, material & construction deficiencies.

Remarks - To save concrete, the design was changed from MG to arch buttress. Weak concrete containing scrap WW1 anti-grenade netting as reinforcement. Workers that reported poor workmanship were fired.



Other Types of Failure



Möhne Dam, Germany

Built 1908 – 1913 to control floods, regulate water levels on the Ruhr, generate hydro power.

Storage 109,000 af.

Breached by RAF Bombers 16 May 1943 using 9,250 lb bouncing bombs containing 6,600 lbs Torpex.

Breach; 260’ wide, 73’ high hole blown into the dam flowing at 484,000 cfs.

The resulting dam breach flood killed at least 1579 people.

The city of Neheim-Hüsten was particularly hard-hit with over 800 victims

Dam Maintenance

The First Step to keeping a Dam in Good Condition

VIDEO-Maintenance-1.50m

Failure of Nash's Lake, Calais, ME


nuggets
©2010 nksnow.blogspot.com
Interval
dam it all...
the Humble Beaver pauses to reflect upon the Infinite Mysteries of Life...

The Development of Emergency Action Plans (EAP's) for Dams

The Use of Geographical Information Systems (GIS) to develop Dam Breach Inundation Maps (DBIM's) for EAP's & Dam Maps for Maine Counties

by

Dan Taylor

VIDEO-TADS-EAP DEVELOPMENT-10:0 m

Dam Emergency Action Planning

- ❑ 1) Visit your dam with the State Dam Inspector.
- ❑ 2) Develop an inundation map.
- ❑ 3) Investigate and visit the downstream area.
- ❑ 4) Hold a meeting with representatives from organizations that may respond to a dam emergency.
- ❑ 5) Keep the Notification Flowchart and Inundation Map updated.
- ❑ 6) Develop evacuation and road closure plans.
- ❑ 7) Compile information into an Emergency Action Plan.

General Guidelines for a Dam Breach Inundation Map

- A DBIM can be the heart of a dam's EAP. It must provide all the ground information needed by First Responders to plan for and manage any emergency at the dam. The DBIM has to be clear, concise and current because it may be used to save lives.

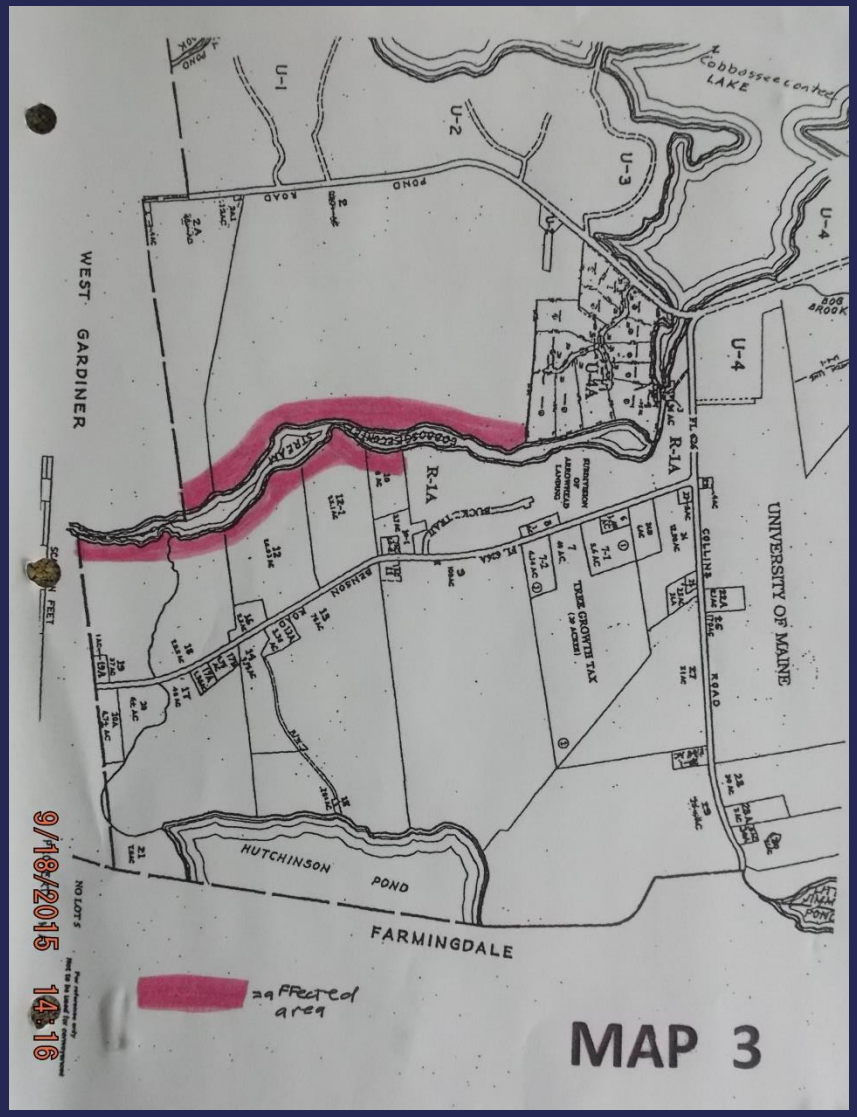
- The DBIM must clearly show natural features, roads, houses, buildings, utilities, and the anticipated dam breach flood line, to a scale that is easy for a group to read around a table, and easy to use during an emergency.

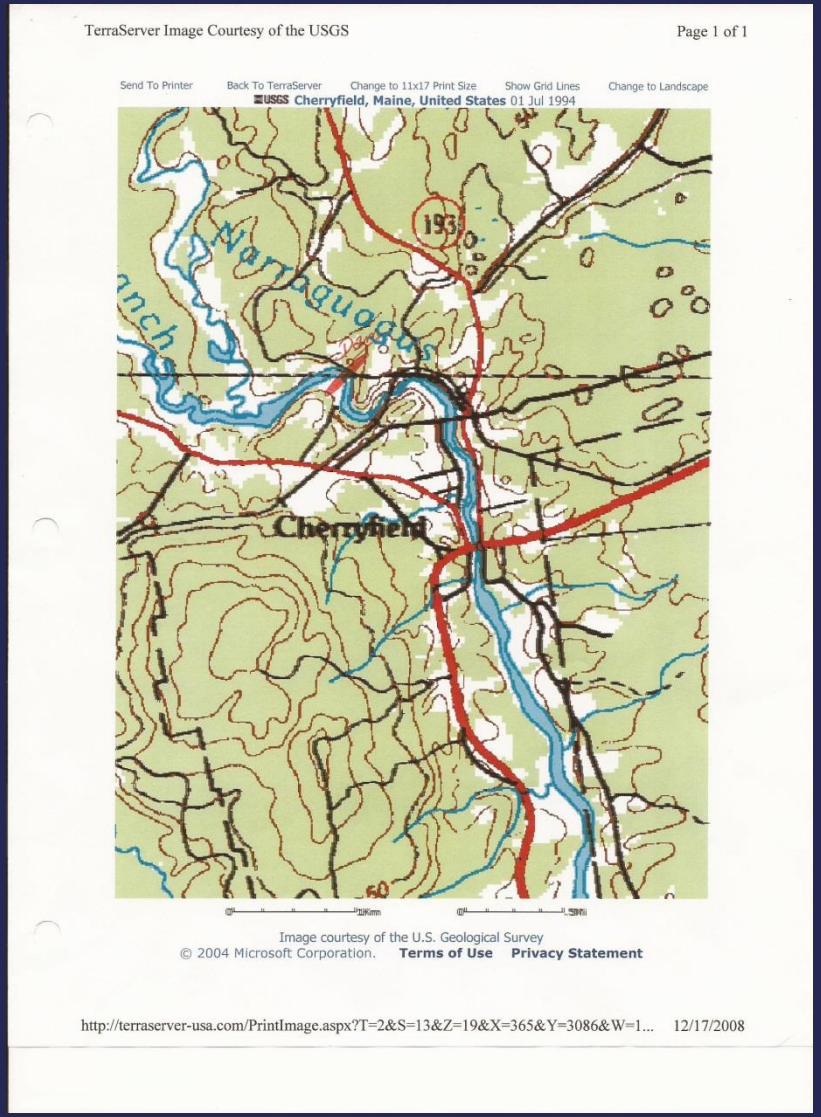
- Other essential details shown on the DBIM after its initial walkthrough, should be evacuation routes, shelters, police & fire stations, schools, pipelines, electricity, and the like.

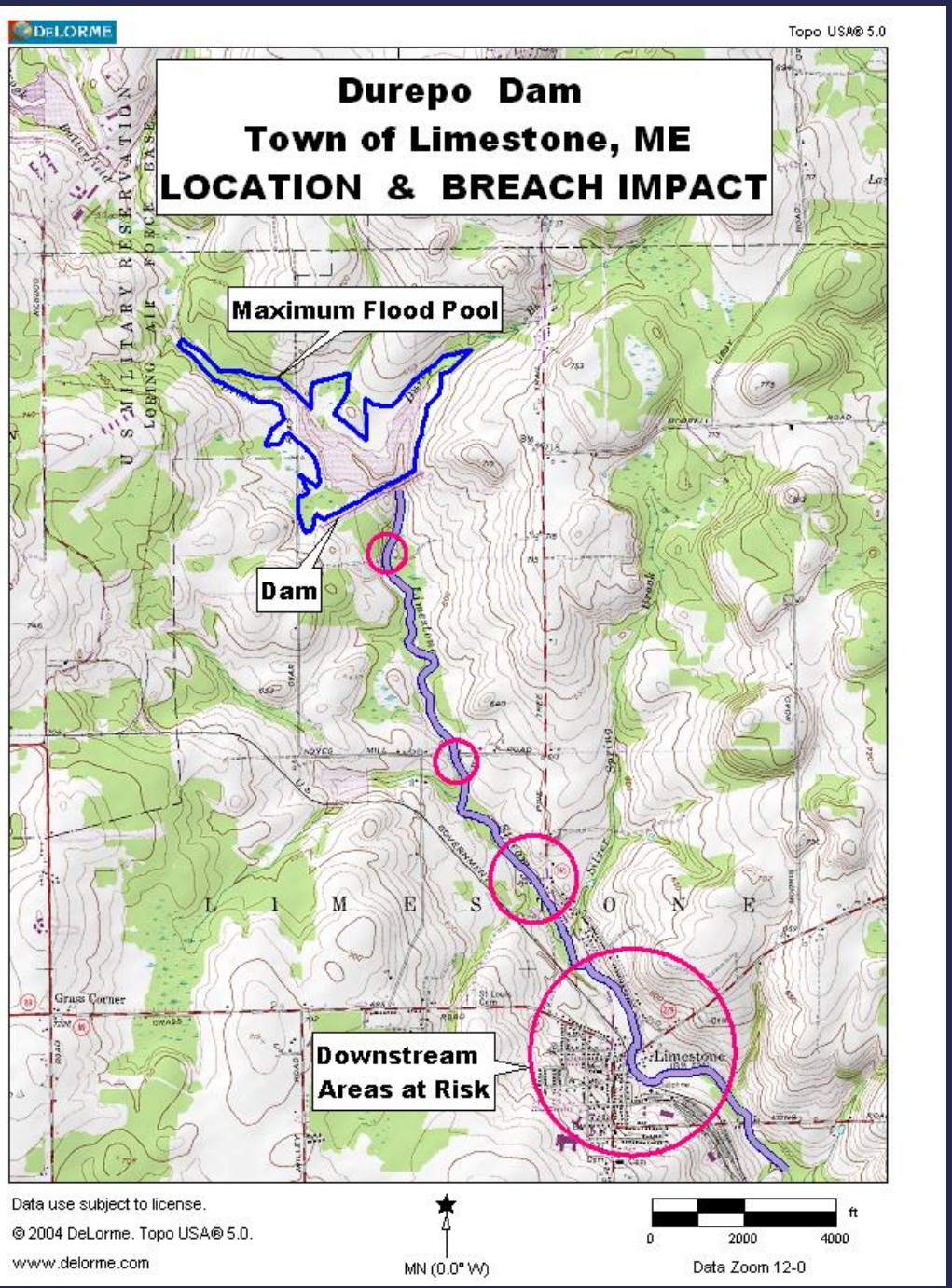
- The DBIM must form the basis of evacuation and road closure planning.

- The map should be updated regularly as new information is entered.

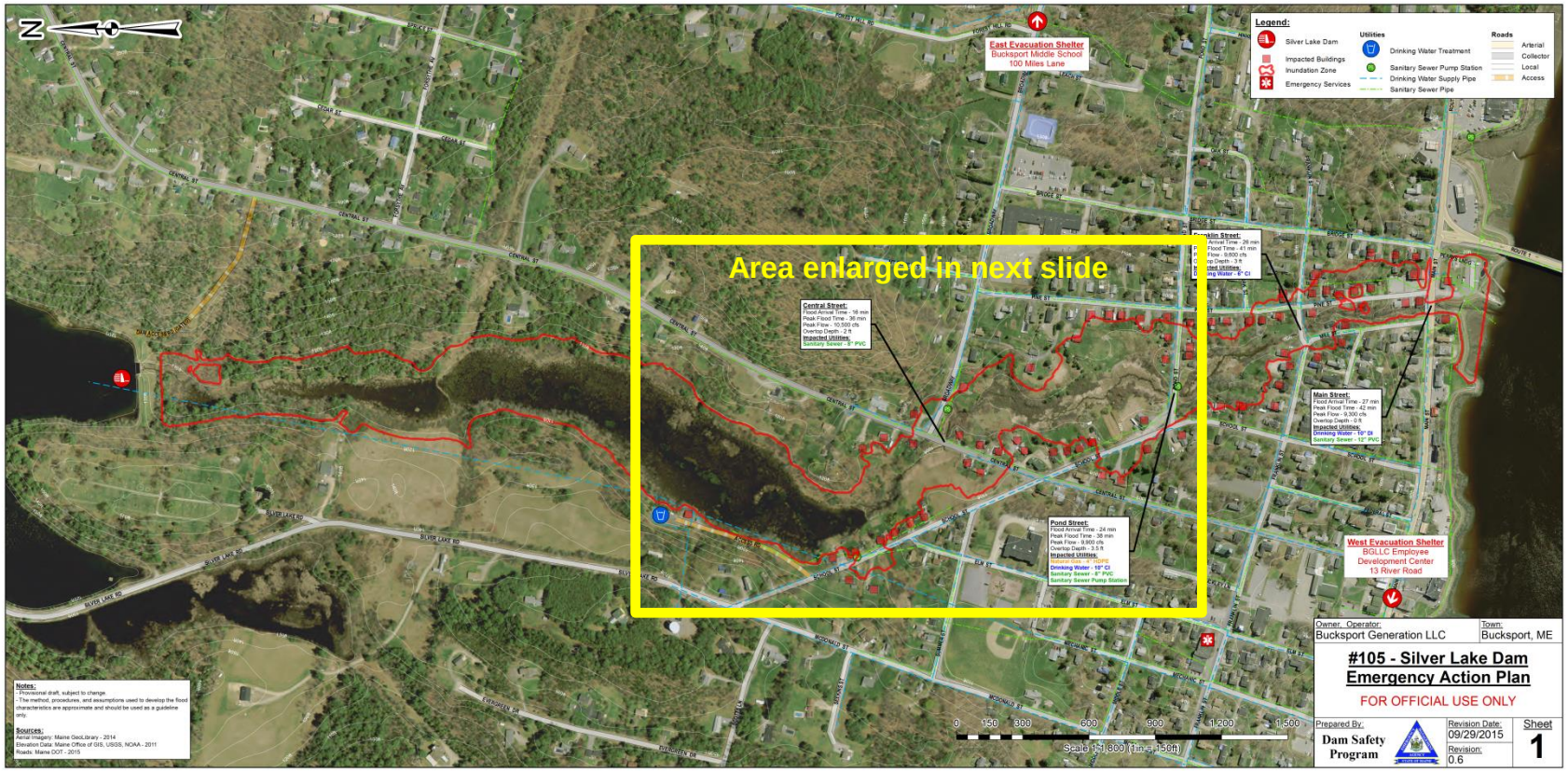
Examples of Dam Owner DBIMs



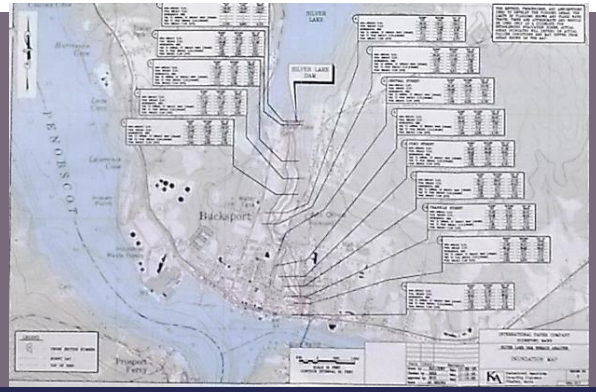



DeLORME
Topo USA® 5.0
Durepo Dam
Town of Limestone, ME
LOCATION & BREACH IMPACT
Maximum Flood Pool
Dam
Downstream
Areas at Risk
L I M E S T O N E
U S MILITARY RESERVATION
LOBING AIR FORCE BASE
Grass Corner
Limestone
Data use subject to license.
© 2004 DeLorme. Topo USA® 5.0.
www.delorme.com
MN (0.0° W)
0
2000
4000
ft
Data Zoom 12-0

Comparing the Current and new DBIMs for Silver Lake Dam

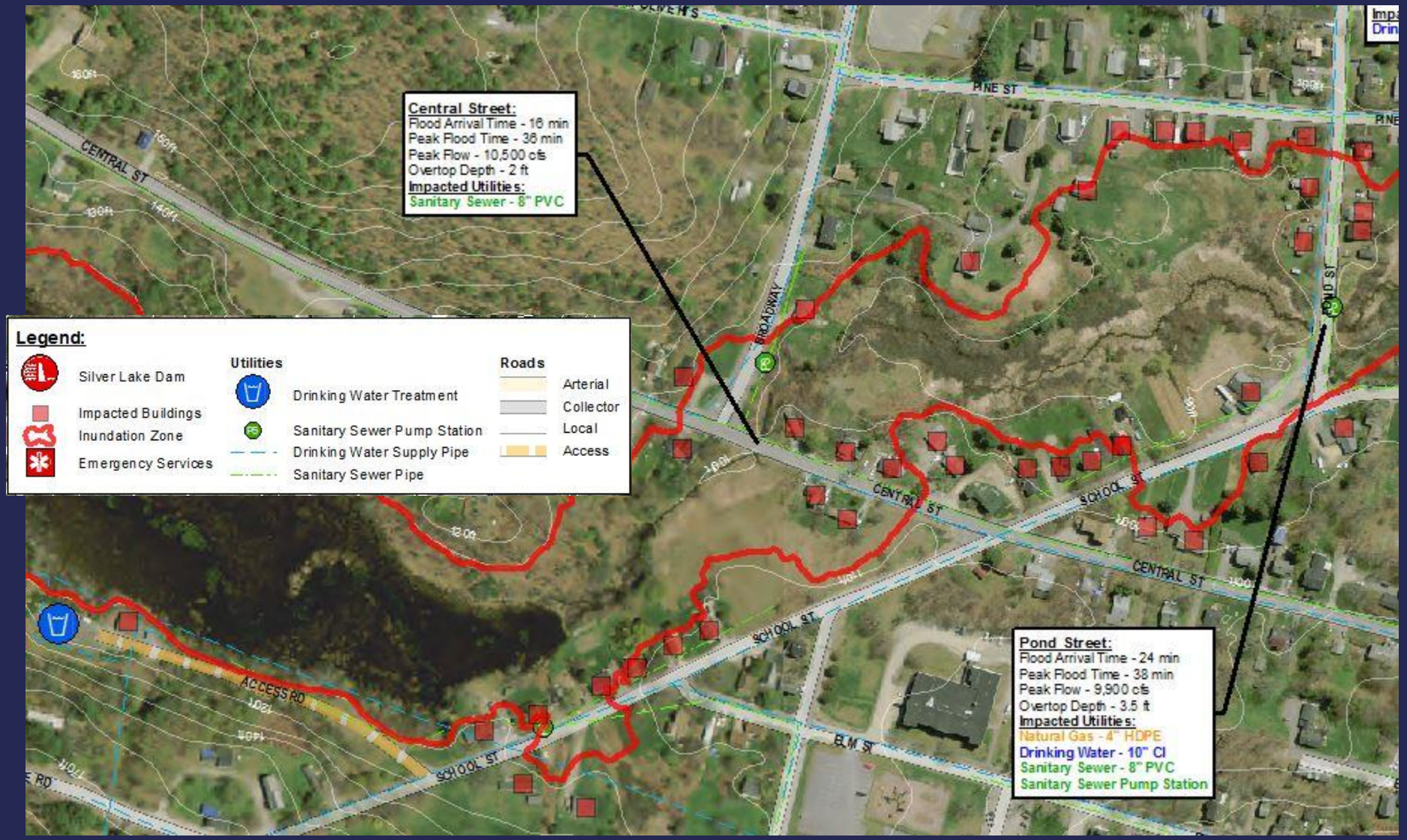


GIS Dam Breach Inundation Maps for Silver Lake Dam, Bucksport, Hancock County, ME

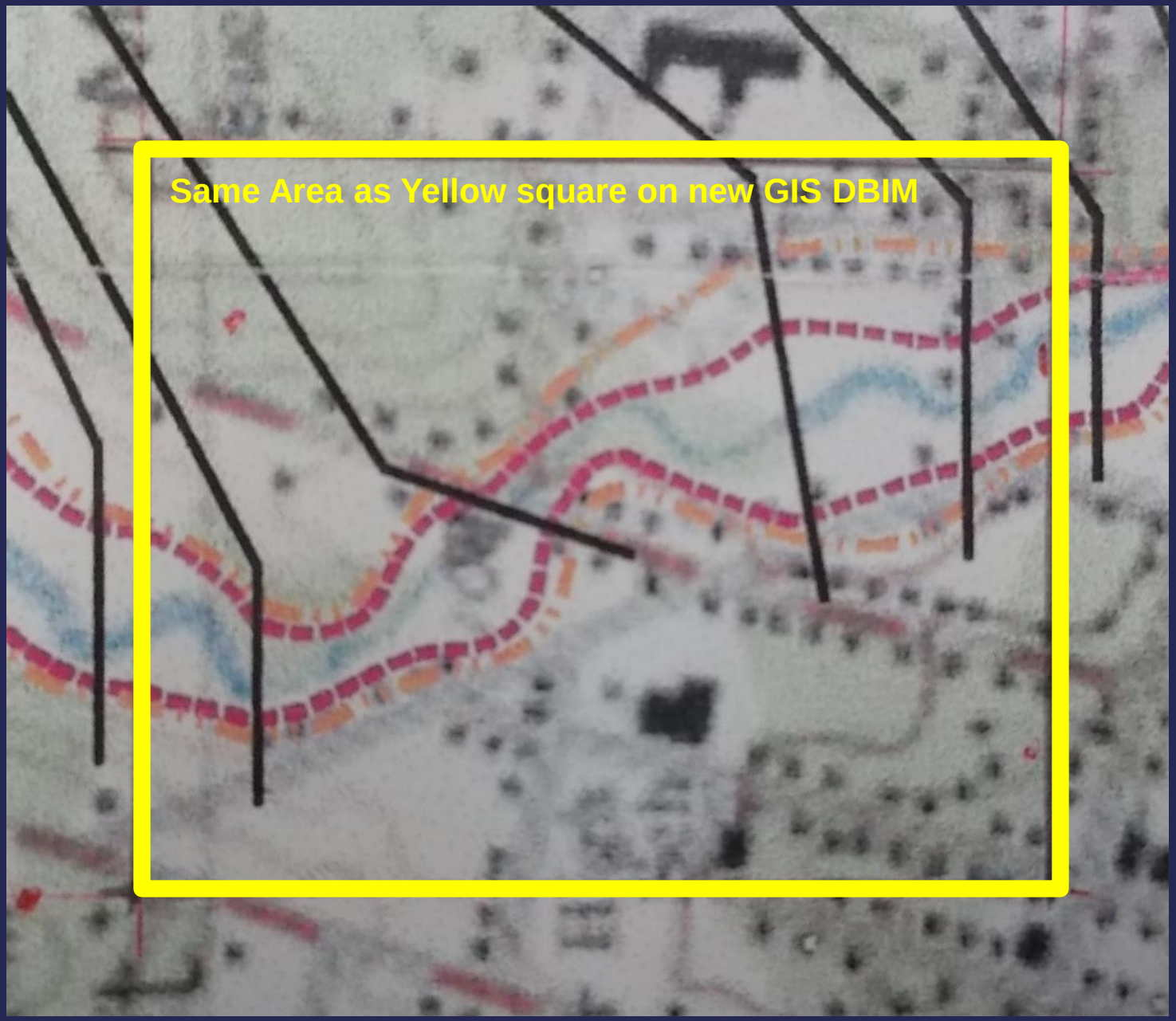


Comparative size of extant and proposed emergency planning maps for Silver Lake dam

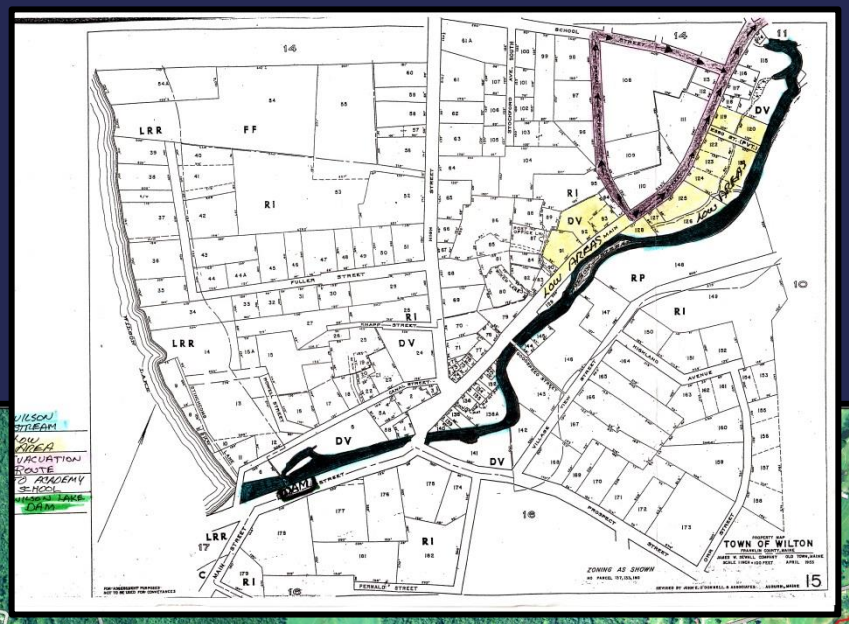
Enlargement (Yellow Square) from new GIS DBIM for Silver Lake Dam

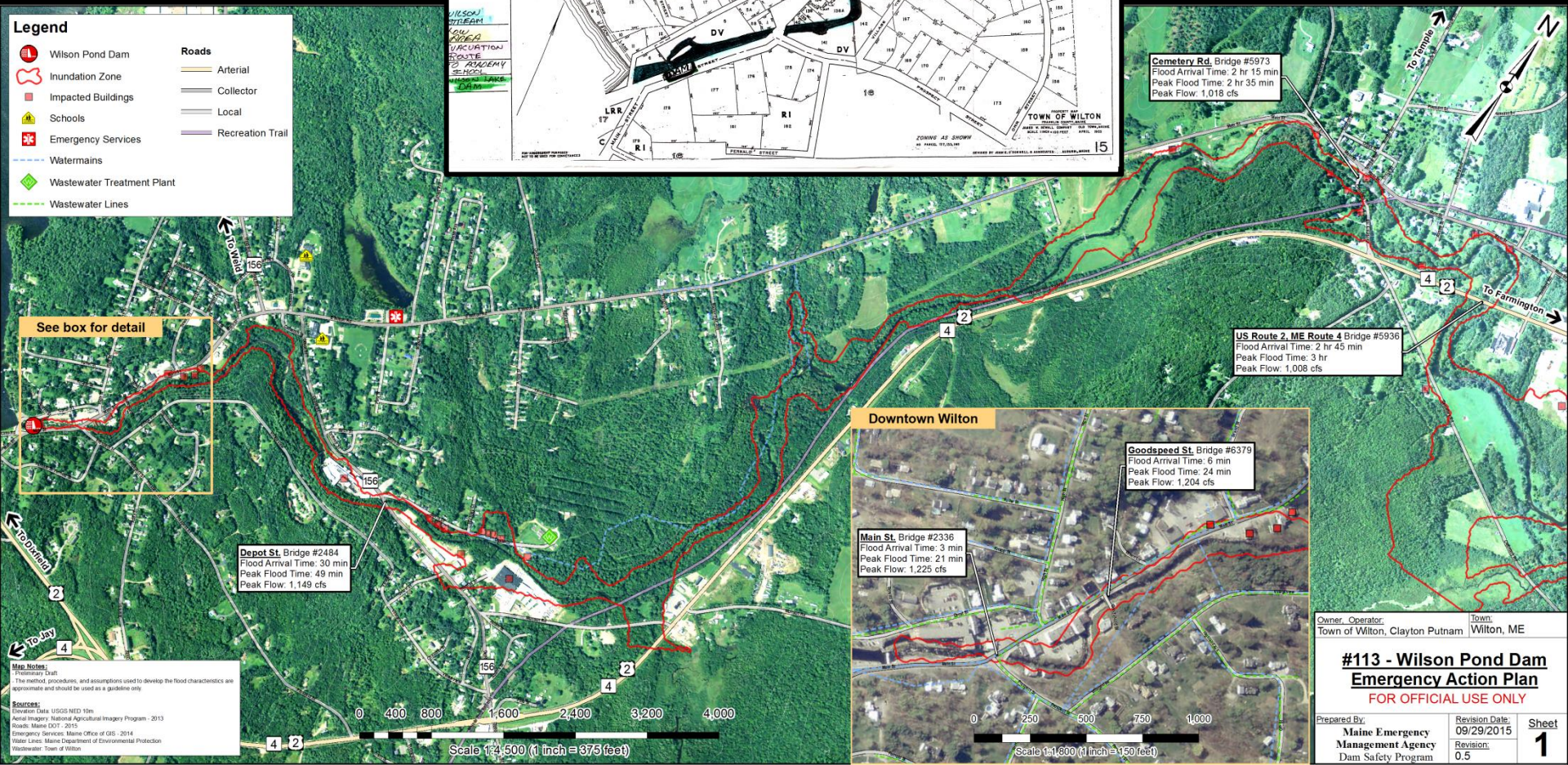


Enlargement (Yellow Square) from extant DBIM for Silver Lake Dam



DBIM for Wilson Pond Dam – Old vs New

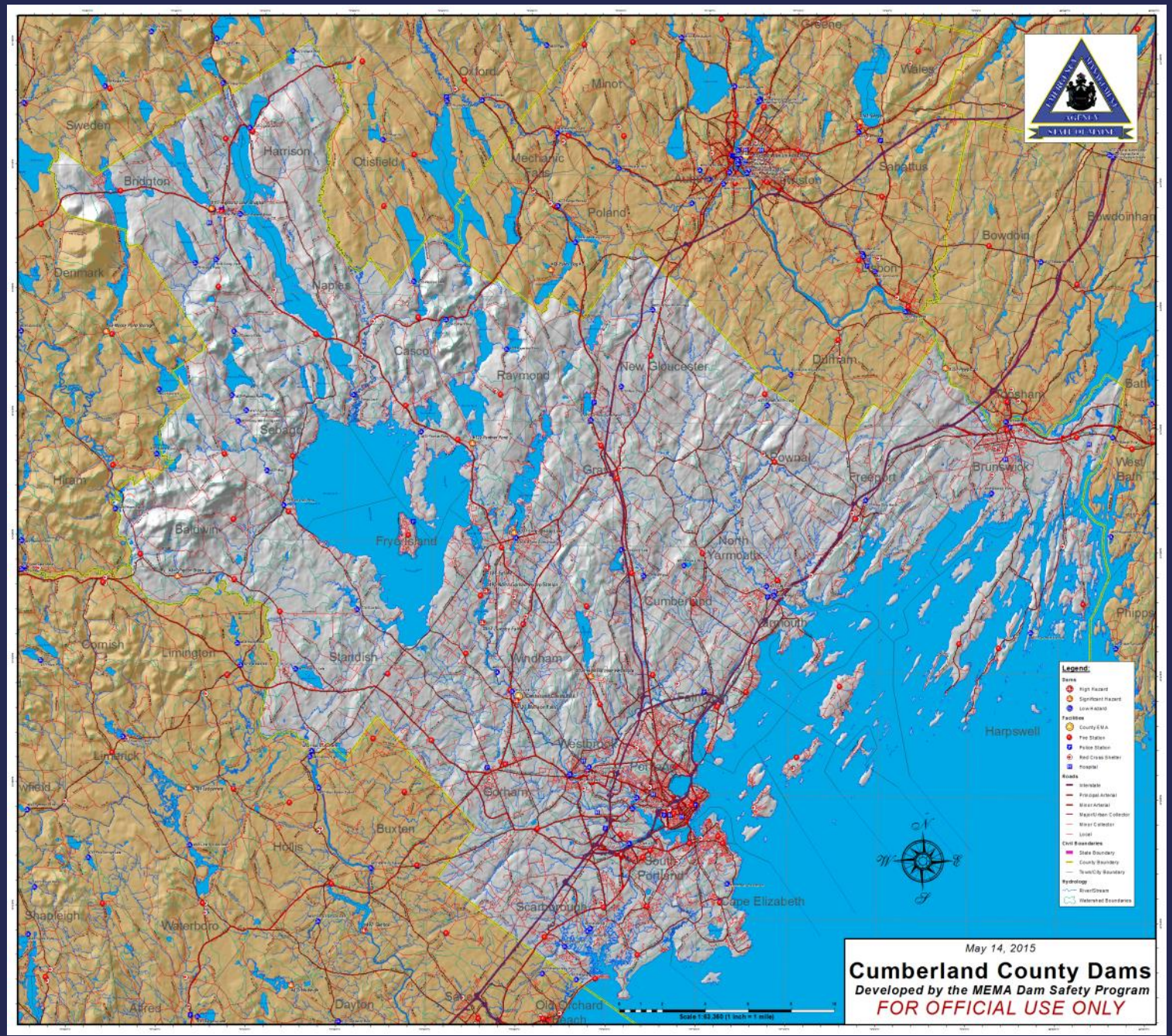




Modelling the Dam Breach

- **Modelling Software: GeoDam-BREACH**
  - Provided by FEMA and developed by URS and NWS
  - Runs within ArcGIS
- **Data Requirements**
  - Digital Elevation Model (LIDAR, IFSAR, USGS NED)
- **Other Datasets**
  - High Resolution Aerial Imagery, Transportation Network, Emergency Services, Drinking Water System, Sewer System, Natural Gas System, Shelters, Population Counts, etc.
- **Method:**
  - Dam Characteristics – Location, Type, Height, Elevation, Breach, Storage
  - Downstream Characteristics – Stream Centerline, Cross Sections @ ~500ft Intervals (Identify Changes in Floodplain)

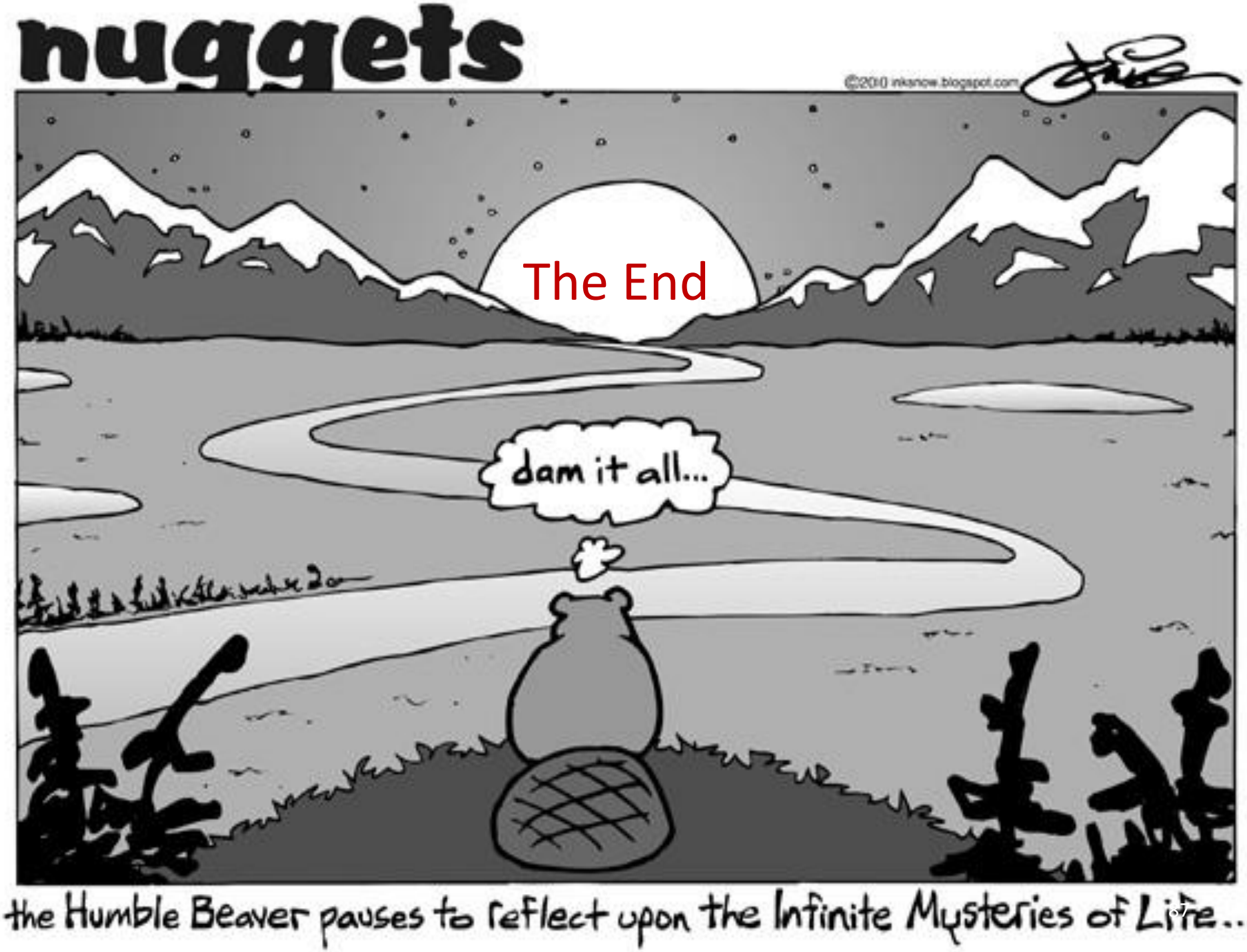
County EMA Dam Maps




Legend:
Dams
High Hazard
Significant Hazard
Low Hazard
Facilities
County EMA
Fire Station
Police Station
Red Cross Shelter
Hospital
Roads
Interstate
Principal Arterial
Minor Arterial
Major/Urban Collector
Minor Collector
Local
Civil Boundaries
State Boundary
County Boundary
Town/City Boundary
Hydrology
River/Stream
Watershed Boundaries
#129-Little Falls
Cumberland County EMA
#123-Mallison Falls
#125-Cumberland Mills
#459.1-Saccarappa East
#459-Saccarappa West
Westbrook
Gorham
Little River
Presumpscot River
Tannery Brook
Indian Camp Brook
Mill Brook
Minnow Brook
MAIN ST
NEW PORTLAND RD
NEW PORTLAND RD
GRAY RD
LIBBY AV
MOSHER RD
ANDERSON RD
METHODIST RD
BRIDGTON RD
DUCK POND RD
BROOK ST
WARREN AV
BRIDGE ST

The previous slides demonstrate

- A dam and its appurtenances is a system designed, built, and operated to store and control water. If that system fails in any way, it becomes a public liability.
- A dam owner should have an Operation & Maintenance Plan to reduce the likelihood of a failure incident.
- A dam should be regularly inspected and monitored to recognize changes and developing issues in the structure over time.
- A well exercised and fully developed EAP, including a clear and consistent inundation map and notification flowchart, is critical in reducing the risk to public safety.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The End
dam it all...
the Humble Beaver pauses to reflect upon the Infinite Mysteries of Life...